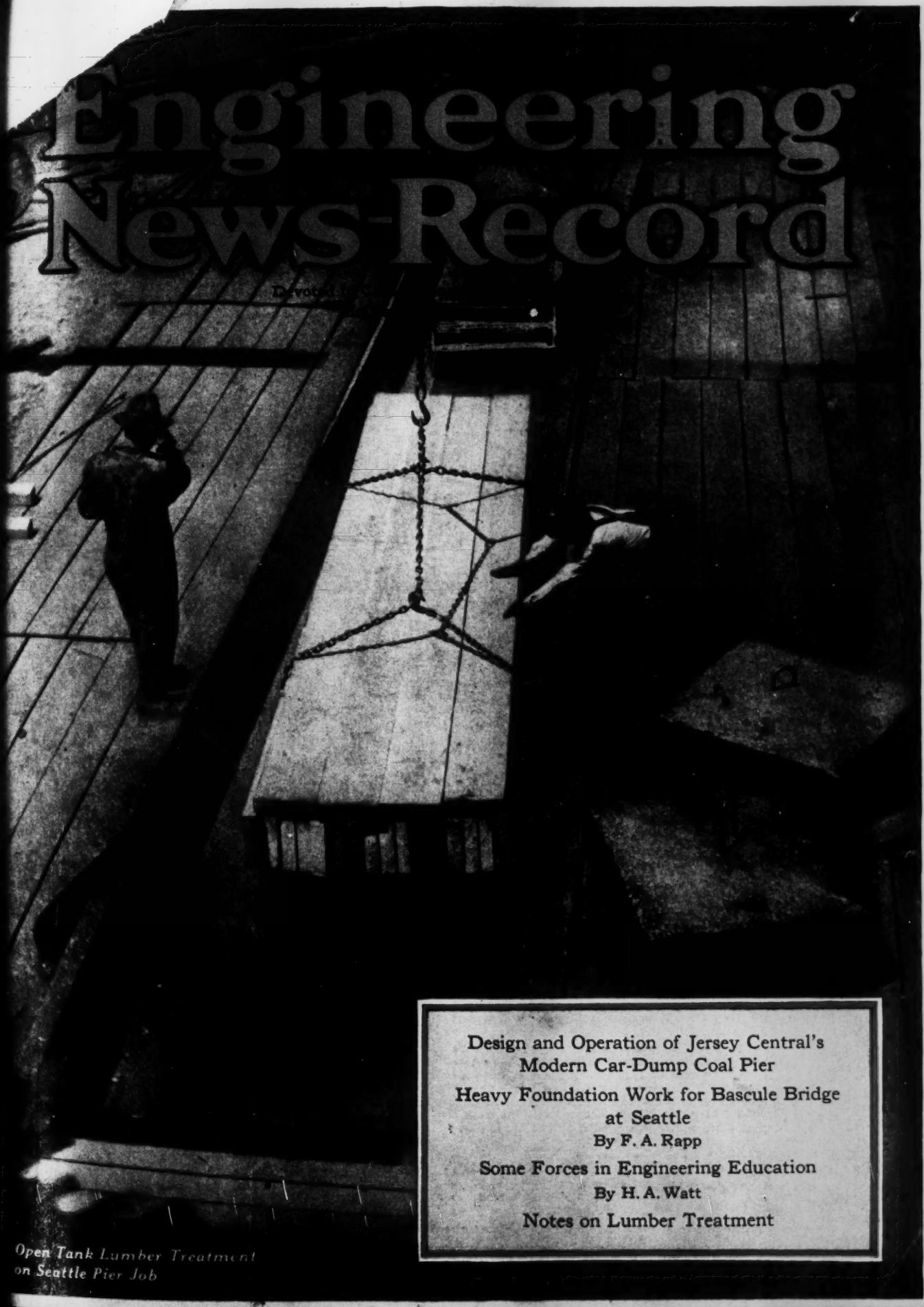
Engineering News-Record



Open Tank Lumber Treatment on Seattle Pier Job

Design and Operation of Jersey Central's Modern Car-Dump Coal Pier

Heavy Foundation Work for Bascule Bridge at Seattle
By F. A. Rapp

Some Forces in Engineering Education
By H. A. Watt

Notes on Lumber Treatment

View — Kreolite Lug Wood Block Pavement, Central Avenue, Cincinnati, O.

The Value of Street Improvement— with

KREOLITE LUG WOOD BLOCKS

"The Paving that's Saving"

The value of a street improvement in the increase in volume of traffic is strikingly illustrated by figures submitted to City Engineer Frank Krug Wednesday, by H. F. Shipley, principal assistant engineer, in reporting the results of a traffic survey made on Central avenue during the week ending November 29.

The report is accompanied by a comparison with a survey made at the same points during the corresponding period of 1918, before the street was repaved. An observer stationed on Central avenue between Fifth street and Carlisle avenue counted 2,786 vehicles (504 horse-drawn and 2,282 motor) pass there within the period of one work day.

The observation made at the same point last year, before the improvement, showed only 730 vehicles passing there in the course of a day. Other observations were as follows:

	1919	1918
Central Avenue, between Eighth and Ninth,	3,790	2,162
Central Avenue, between Elizabeth and Clark	3,100	624
Central Avenue, between Clark and Hopkins	3,188	651
Central Avenue, between Clinton Street and Armory Avenue	2,813	411
Central Avenue, between Armory and David,	2,647	473

In this year's count the motor-driven vehicles outnumbered the horse-drawn by nearly 6 to 1.

—Cincinnati Times Star.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 84 — NEW YORK, THURSDAY, APRIL 15, 1920 — Number 16

New Am. Soc. C. E. Year Book

FOR years there has been good-natured criticism of the segregation in the annual Year Book of the American Society of Civil Engineers of the different grades of members, which necessitated the use of two lists if one did not happen to know the grade of the member whose initials or address was sought. In the new year book, just out, a single alphabetical list contains the names of members in all grades. This will be a great convenience.

City Engineers Should Go

ATTENDANCE of city engineers is especially desired at the National Conference on City Planning to be held in Cincinnati, April 20 to 22. City planning is a field in which city engineers should be leaders but thus far relatively few have given attention to more than a single element of the subject at one time, and even that has been without recognition of its broader aspects. The small band of engineers who have had city-planning vision should be heavily reinforced and a large attendance at the Cincinnati conference would be a good beginning. Besides the presidential address by Nelson P. Lewis, chief engineer of the Board of Estimate, New York City, three other engineers are on the Cincinnati program and the toastmaster at the annual dinner on April 21 will be Herman Schneider, dean of the College of Engineering, University of Cincinnati. City engineers should go to Cincinnati in force.

The Railroad Strike

ALTHOUGH a few railroad officers more than a month ago privately predicted a general railroad tie-up before the first of May, the unauthorized strike which has apparently become nation-wide over night comes almost as a complete surprise. At this writing, the situation is so veiled in mystery that any attempt at thorough analysis is futile. But one thing appears certain: The radical forces of the "one big union" idea have laid a groundwork to destroy the old unions through secret local organization and intimidation—minority methods of controlling the majority. Secrecy has been the characteristic of the radical organizer's operations and he has struck at the most vulnerable point—the roughest class of railroad workers and therefore the most susceptible to syndicalist methods. From the switchmen, the strike, unauthorized and opposed by the recognized unions, has spread into the ranks of enginemen and trainmen—either through intimidation or the hysteria of discontent over wage-settlement delays in Washington. In spite of strong opposition to the strike movement already manifest in some locals of the recognized unions, the situation is menacing. Unaccompanied by any definite statement of aims and demands, the secret strike orders generally seem to have been abjectly obeyed. Previously, this journal has favored the passage of a Federal law against strikes without warning and without a period of discussion. Such a law, as in Canada, might have gone far to forestall what now threatens to become the most destructive of American strikes. A sharp issue has been drawn between the interests of the public and those of a special class—and the method used is anarchic. There have been tests already of the public temper; there is no room to doubt what the attitude of the public will be. With the people against them, no matter how great the inconvenience or the temporary victory, the strikers must eventually lose. Victory for them would be a blow against Government.

Construction Industries Create Staff Council

THE success as a constructive agency of the National Federation of Construction Industries, whose organization, as noted April 1, p. 689, was completed in Chicago on March 24-26, will depend upon how efficiently the staff council can be made to function. Composed of the staff experts of the member firms and associations this council is virtually the production department of the Federation. Its task will be to plan and execute the improvements in legislation, transportation, industrial relations and standardization to which the Federation will chiefly devote its energies. To undertake this task a very definite and purposeful organization of the staff council is essential. At the meeting in Chicago such organization was well begun, but it was only begun. Between now and the next meeting it must be completed. With this work well done, the Federation will be prepared for creative work.

Another Vote on Shear

RADICAL increases in the safe unit stress in shear in reinforced concrete were proposed by the special committee on shear at the annual meeting of the American Concrete Institute in February. These proposals were discussed at the sessions and were incorporated in the proposed Standard Building Regulations of the institute and as such sent out to letter ballot, to be canvased April 17. Unfortunately, however, the request for a vote did not include a reprint of the shear provisions which, indeed, in the form adopted were never before the membership in general. Any vote on this letter ballot, therefore, will be anything but authoritative, nor can it reasonably add any weight to the conclusions of the committee which, though composed of engineers of the greatest competence in this matter of shear, is opposed in some of its contentions by other engineers of equal competence. If its constitution permits, the institute should at once submit the complete "Building Regulations" to its membership and should not stand on the vote of April 17 as an approval of the provisions of those regulations.

Salaries and Service at Worcester

PENNY wise and pound foolish is the policy of those cities that are refusing to pay the members of their engineering staffs salaries commensurate with the value of their service. A striking case in point has arisen at Worcester, Mass., where F. A. McClure, after serving the city 43 years, during 28 of which he has been city engineer, is now paid only $4,000 a year. The Mayor has recently denied Mr. McClure an increase of as little as $1,000 a year, having vetoed this and other salary increases voted by the City Council on recommendation of its finance committee. The Mayor bases his veto on the ground "that the taxpayers do not approve of such large and wholesale increases"—as though he were closer to the people than are the members of the City Council.

In a newspaper interview, Mr. McClure states that his $4,000 salary is no more than equivalent to half the sum a few years ago; that besides his other work he has in hand the designing of $2,000,000 of sewage-works improvements which no reputable engineer in private practice would undertake to put through in the year available to him for less than $70,000, but that notwithstanding this he is about to lose his assistant on the sewage-works design, Earle W. Greene, because the mayor refuses to permit an increase of $400 a year ($2,600 to $3,000) to this assistant.

There is no question whatever as to Mr. McClure's faithfulness and ability, nor of politics at issue—unless the Mayor's opposition to any material increase in salaries is politics.

The sole question in Mr. McClure's case is, shall a man who has served a prosperous city for nearly three decades as city engineer and for over four decades altogether, who knows the city like a book, be allowed to resign in discouragement for lack of a reasonable increase in salary?

The case put up to the people of Worcester is one of justice and gratitude, combined with good business. Moreover, Mr. McClure would gain financially if he left Worcester, as a California city has offered him an important engineering position at double his Worcester salary. But after so long and faithful service as Mr. McClure has rendered, it would be a sting to him and a reproach to Worcester if he were permitted to go to other employ, either public or private, when a small increase of salary, to provide a mere living wage for a professional man, would retain his services and affection for his home city and prevent an uprooting that will be painful to him and his friends within and without the city service.

An official and citizen like Mr. McClure is an asset to any city that cannot be measured in mere dollars. Fortunately, the Chamber of Commerce and many leading business men of Worcester realize this and are determined not to lose Mr. McClure. The least the City Council can do in the way of justice and good business is to override the mayor's veto of the salary increase for Mr. McClure—and of other well-deserved increases also. Skimping salaries of able city officials may possibly save a few drops at the spigot but it is certain to waste bucketsful at the bunghole. This is especially true when a city is launching extensive improvements to works with which an engineer has been long connected, as is the case with the Worcester sewage-works and City Engineer McClure.

The Canadian Railroad Deficit

COMPARED to the huge loss sustained by the Government of the United States for two years of Federal railroad operation, the deficit of $47,000,000 recently reported to the Canadian Parliament as the year's loss on the National Railways does not seem great, though it is nearly double our rate of loss per mile operated. But its significance is such as to have brought down a storm of criticism of the government's railroad policy, due largely to the permanent rather than the temporary nature of the situation. In spite of the reassuring tone of the report of the Minister of Railways and Canals, from which figures were briefly abstracted in our News Section last week, Canada's government-owned and operated railways are likely for some time to have troublesome financial problems.

Following a period of ill-advised and hysterical railroad building, backed by government guarantee, the Canadian Government found on its doorstep and was compelled to take over and operate a great railroad system comprising the lines of the National Transcontinental, the Canadian Northern, and more recently the Grand Trunk Pacific. By exchange of private for government securities, the Dominion acquired not only control but also ownership of about half the trackage in the country, so that the situation is anything but temporary. In competition with the Canadian National Railways, a losing venture for the present at least, is the strong privately owned and operated Canadian Pacific Railway earning a substantial dividend while charging the same rates.

Apparently an entirely different situation from that in this country, there is at least one point of striking similarity. The same fear exists in Canada that, by raising rates to make the losing lines self-supporting, the strong system may earn too great a dividend, since it must be allowed the same rates. While the National Railways have sustained a deficit of $47,000,000, it is estimated that the total cost to the people of raising rates to make the National lines self-supporting would be some $88,000,000, the difference being represented largely by increased net earnings of the Canadian Pacific through higher rates.

In this country there has been established by the new Transportation Act the principle of the "take-off" above a fixed percentage of property "value," to offset the fear of big dividends accruing to the strong companies. In Canada it is proposed by some to raise rates and then tax the increased profits out of Canadian Pacific earnings. At best such procedure would be of doubtful success and propriety. Means might well be found to evade the taxation and there would be the criticism of the Government's using its strategic position to tax an earned dividend out of a competitor.

As stated previously by this journal, the acquisition of losing lines by the Canadian Government was the inevitable result of a period of overbuilding, aggravated by the war conditions which followed. It is true that much of this extension was justified for purposes of colonization and therefore a loss on some of the lines for several years to come may be considered legitimate. Cognizance is also taken in Canada of the fact that the establishment of new rates in this country will largely determine the course taken in Canada, as was the case in applying the McAdoo wage increases to the Canadian railways. It appears likely that the readjust-

ment may embody a compromise measure providing for a raise in rates which, while sufficient to increase Canadian Pacific earnings substantially, will not be great enough to offset the entire loss on the National Railways. On the whole such a course now appears most desirable, but the financial outlook for government ownership in Canada is certainly troubled.

Engineers, Contractors, and a Sane Immigration Policy

THERE was held in New York last week probably the first adequate conference on immigration that the country has known. The conferees were representatives of racial groups, manufacturers, farmers and educators. The approach was from the economic, not from the sentimental, side. It was brought out, among other things, that, due to the European war and the operations of the literacy test, we are short 5,000,000 immigrants; that, while emigration and immigration now nearly balance, 75 per cent of the emigrants, but only 25 per cent of the immigrants, are unskilled workers; that, due to the educative efforts during the war a larger than normal number of unskilled were turned into skilled workers and that the vacuum has not been, and is not being, filled; that the barriers against the mental and physically diseased and against the agitators should not be let down, but that, on the contrary, the literacy test should be repealed, since it gives no index whatsoever of the immigrant's desirability—Lenine and Trotzky could pass it with flying colors; that an intelligent immigration policy requires not merely laws covering admission, but administrative machinery which will protect the new arrivals from sharpers, see to their distribution and give them fatherly protection and counsel until they are settled

We need not discuss these points in detail. We believe that they will appeal strongly to the readers of *Engineering News-Record*. Two of them will warrant brief restatement since they demand the active sympathy and support of engineers and contractors—for surely no line of endeavor is suffering more through the cutting off of immigration than the building of civil engineering works.

The literacy test, we all know, is a device of organized labor to create and maintain a labor shortage—and the public suffers. No one wants to see unemployment; on the other hand, no one, except the immediate beneficiaries, wants to see so acute a labor shortage as that which today is largely responsible for high prices. The effect of the literacy test is to keep out those of willing hand, but little book learning, whose co-operation is essential to all civil engineering enterprise.

It serves no sound purpose. The rogues, the communists, the socialists, the anarchists are not found among the ignorant—though when here they furnish fine subjects for propaganda for the native and the foreign-born book-taught agitators. Engineers and contractors, individually and in their organizations, should stand for the repeal of the literacy test. Incidentally, they will be in good company. Cleveland and Taft and Wilson vetoed such tests; the present statute was passed over the presidential veto.

The other point we want to emphasize is the need for a sensible immigration policy. Now we let the immigrant in, and at the very gateway turn him over to the tender mercies of scoundrels and sharpers. Defrauded right and left, robbed, even after he has been here for years, of his savings in private banks, he develops a justified hatred and cynicism. Canada and other countries do it differently. They do not relax their care till the immigrant is settled in his new home; in some cases they give him land, in others make loans at reasonable terms; but always they recognize their obligation to protect and help him. On this point, too, engineers and contractors should voice an opinion.

Obviously we do not want unrestricted immigration. On the other hand it must not be needlessly—or viciously—restrictive. We do not want the incompetent or the unfit. We do want the willing, industrious, frugal, quiet living, decent, healthy and moral men and women, from the European countries at least.

Prohibition and the Foreign Born

WE commented some months ago on the favorable effect which prohibition had had in the stabilizing of railroad maintenance labor. Another side of the case, though, was brought out at the Immigration Conference in New York last week. It has been found that prohibition is a material factor in promoting emigration and that it is being laid before prospective immigrants as one of the reasons why they should go to some other American country than the United States. It will not do to pooh-pooh the situation if we regard our labor shortage as serious. The facts have been ascertained by various investigators, while the probable effect of our prohibition laws is one of the favorite topics in European newspapers. An example of the discussion is afforded by the following extract of a letter in the London *Times* of March 23 from no less a man than Stephen B. Leacock, the distinguished economist of McGill University, Montreal:

"The argument is advanced that prohibition is destined to render the United States a formidable industrial competitor. It is deplorable to note that this reasoning has recently been voiced in no less a place than the House of Commons. There is nothing in it. The United States is a formidable industrial competitor in any case. The fact arises from its vast territory and resources, the energy of its people, and from its economic relation to the great war. It was not reared to industrial greatness on the milk-pap of prohibition. The Puritans drank rum. George Washington took his wine, and the iron and steel industry grew up on the beer of St. Louis and Milwaukee. The industrial greatness of American did not wait for Jan. 16, 1920. Indeed, the contrary is true. Under prohibition the workers are restless and discontented. They have been robbed of the simplest comforts of life at the dictates of a fanatical minority. Prohibition plays straight into the hands of the agitator and the Bolshevist.

"The most serious warning is needed for decent British people of any class who think of migrating to the United States and to the dry provinces of Canada. They will reap nothing but bitter regret. Let them come instead to the spacious and hospitable province of Quebec."

This will be bitter reading for those prohibitionists who regard the taking of a drop of liquor as a deadly sin, but while we are considering the need of immigration we had better, as a mere problem in economics, inquire calmly into the advisability of altering this, too, of the factors that are deterring immigration.

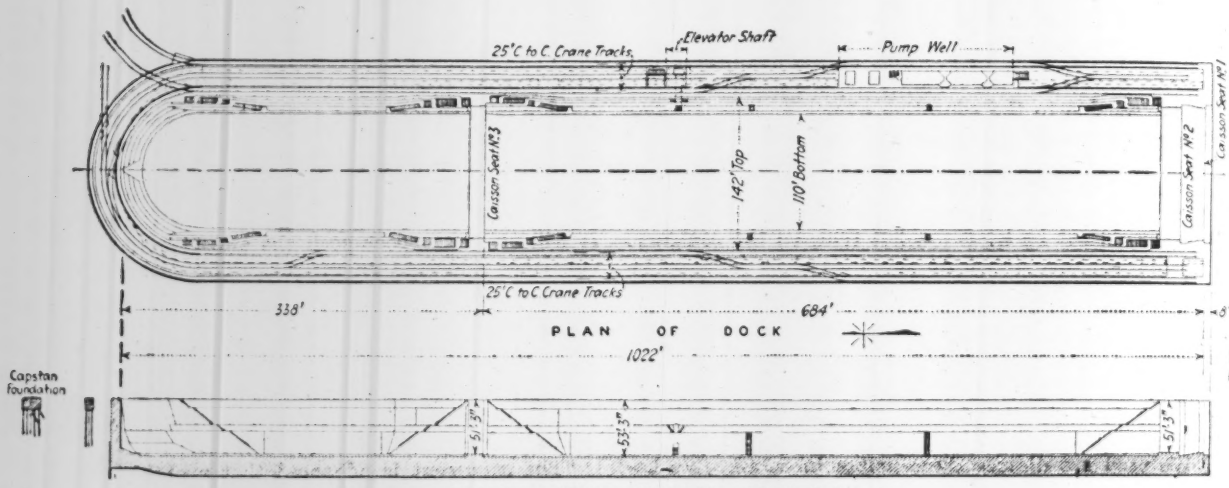
Soft Ground Complicates Dry-Dock Construction

Excavation for Navy Graving Dock at Philadelphia Opened Water-Bearing Material, Which Led to Dividing Area into Number of Small Cofferdams

By Charles A. Lee

Lieutenant Commander, Corps of Civil Engineers, United States Navy, Navy Yard, Philadelphia, Pa.

WATER-BEARING strata, not indicated by a fairly extensive set of preliminary borings, made necessary some decided changes in the construction of the Navy's big graving dock now being built at the Philadelphia Navy Yard. Instead of simple suction dredging for the main excavation, it has become necessary to divide the whole area into a number of sheet-pile cofferdams some of which have been extremely difficult to hold, and to revise the design of the dock walls from a cellular section to a solid one with a relieving wing base. The foundation work is now well along toward completion.



PLAN AND SECTIONAL ELEVATION OF UNITED STATES NAVY DRY DOCK NO. 3, PHILADELPHIA NAVY YARD

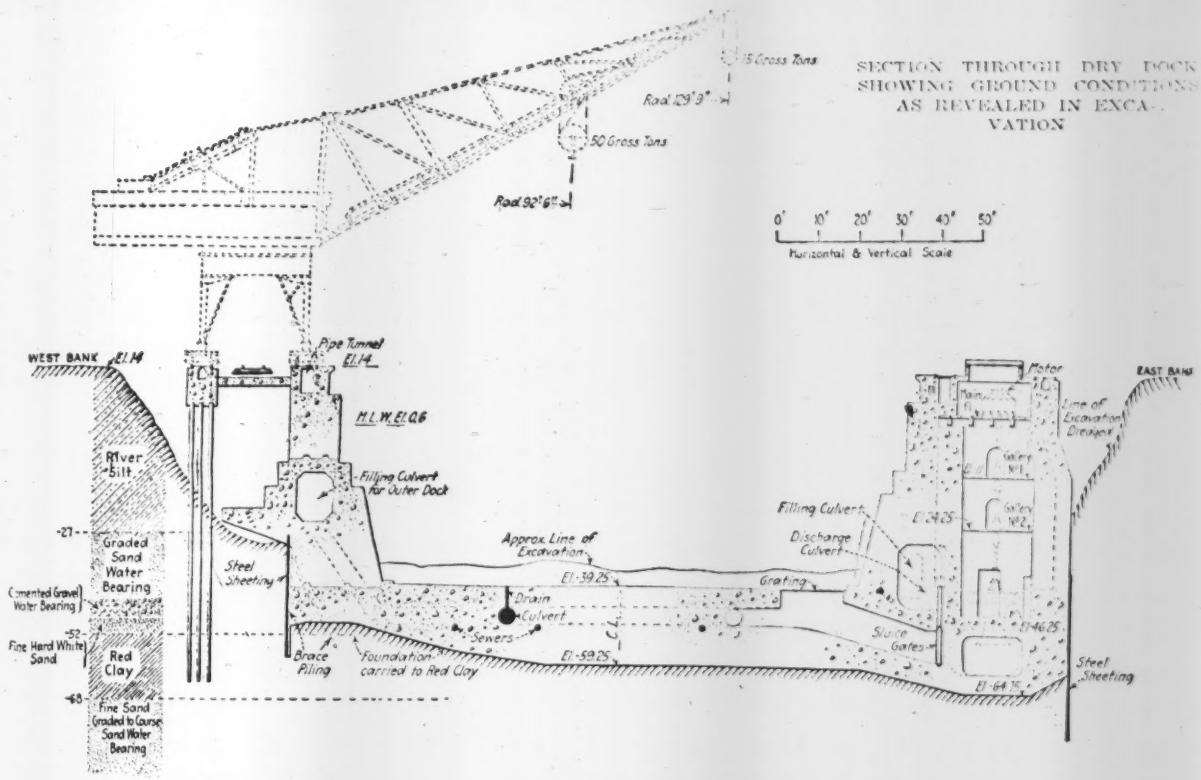
The dock, known as Dry Dock No. 3, will be, when completed, one of the largest in the world. The size is the same as that of the one recently completed at the United States Navy Yard at Portsmouth, Va., described in *Engineering News-Record*, of Sept. 11, 1919, p. 494. The length is 1,022 ft., between the head of the dock and the outer caisson seat, the width at the floor is 110 ft. and at the coping 144 ft. The depth from the coping level to the floor is 53 ft. 3 in. and over the sill at the entrance 51 ft. 3 in. At mean low tide the depth of water over the entrance sill will be 37 feet 10 inches.

It is designed to accommodate the large battleships and battle cruisers now authorized to be built, but the limit of size has been determined by the capacity of the Panama Canal locks, the maximum size of ships it is possible to dock being slightly over 1,000 ft. long with a beam of 110 feet.

The construction of this project started early in 1917. The original scheme was to remove practically the entire amount of excavation by means of a suction dredge working behind the earth cofferdam built across the dock entrance. About 460,000 cu.yd. of material was removed in this manner, and the bottom of the entire excavation was brought down to elevation about — 27 to — 30. It was found practically impossible to dredge more deeply than this, as the banks slid in as fast as more bottom excavation was removed, and it was impossible to maintain any reasonable side slopes. At this time the dredge was removed, the cofferdam completed and the excavation pumped out. It was found that after the dredge had cut through a heavy deposit of river silt the cutter had entered a deep stratum of water-bearing sand. When it was attempted to excavate into this, the water naturally washed it out and allowed the banks to drop.

These conditions made it impossible to follow out the original plan for building the dock, and it became necessary to modify the design, as well as the method of construction. The original design was similar to that of the Portsmouth dock, with solid floor and cellular side walls, but in the revised design the side walls are solid and designed as retaining walls. The general design is as shown in the sketch of the typical cross-section herewith.

Before the construction was started, numerous borings had been made at the site to determine the nature of the underlying material. These borings developed the fact that the entire site was underlaid by a heavy stratum of tough red clay, which insured a good foundation. These borings, however, did not furnish sufficient information to make it possible to foresee the difficulties due to excavating through the sand and gravel overlying the clay. After the dredge had finished excavating, another set of core borings was taken to check the first ones. Conditions varied slightly in different parts of the site, but a typical cross-section of subsurface conditions is shown on the accompanying drawing.



SECTION THROUGH DRY DOCK SHOWING GROUND CONDITIONS AS REVEALED IN EXCAVATION

The last set of borings proved that the red-clay stratum formed a continuous blanket under the entire site, with an average thickness of over 18 ft. Below the clay is a layer of very fine and tightly compacted sand of varying thickness. This sand becomes coarser as the depth increases. When the test holes had been sunk to about elevation — 75 or — 80, water flowed freely from the tops of the casings at elevation about — 30, and at 5 ft. greater depth it spouted from the casings. Pressure gages were applied, and showed 10.5 lb. per square inch, or approximately equivalent to the head of water in the Delaware River, indicating that the sand stratum has direct connection with the river bottom at some point near the site. This fact made it necessary to exercise great care, in order to avoid breaking through the clay, and before proceeding with the work it was determined that the clay was deep enough to leave ample thickness below the deepest parts of the excavation. It was also considered advisable not to open up any large area of bottom excavation at one time, but to place the concrete floor as the bottom was dug out.

In order to carry the excavation to the required depth to allow for placing the floor and the deepest portions of the pump well, it was decided to surround completely the bottom excavation with a cofferdam of steel sheeting driven well into the red clay, and braced on the inside with plumb and batter piles on 5-ft. centers. The length of the sheeting varies from 26 ft. where the clay is nearest the surface to 44 ft. in the deepest parts of the dock. Lines of sheeting were driven 81 ft. on either side of the dock center line, and completely surround the head end. This gives sufficient width for the floor and for the foundations for two side walls. Fourteen-in. Lackawanna sheeting was used having a weight of 40.8 lb. per ft. Nearly 75,000 lin. ft. of sheeting was driven, having a total weight of about 3,100,000 lb. Great difficulty was experienced in driving a large part of the sheetings, on account of the very hard stratum of cemented gravel and hard white sand through which it must be driven before penetrating into the red clay. In spite of the fact that the type of sheeting used is the strongest and heaviest procurable, much of it was found to be badly bent and torn apart, when the material was finally excavated. In order to minimize the amount of water to be pumped from the bottom as the excavation proceeded, the cofferdam was divided into sections 300 to 400 ft. long, by driving crosswebs of sheeting between the side walls at suitable intervals.

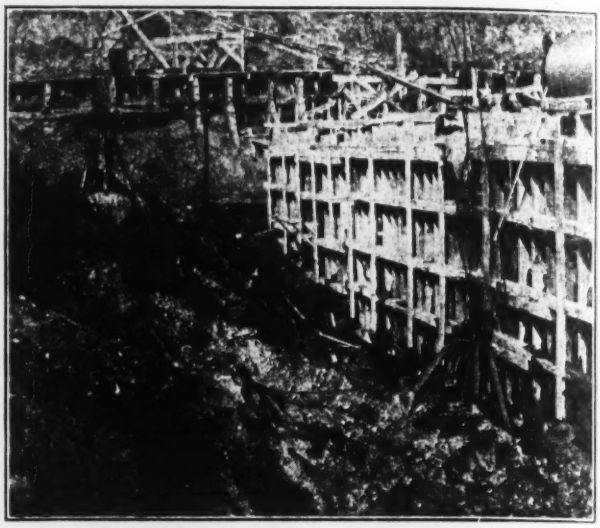
Both steam and drop hammers were used in driving sheeting, as many as seven drivers being in operation at one time. Although the heaviest steam hammer procurable (No. 0 Vulcan) was used, a heavy drop hammer of from 3200- to 4200-lb. weight proved more satisfactory than the steam hammers. The heavy solid blow had more effect than the quicker, lighter blows of the steam hammer, which only resulted in bending and battering over the heads of the sheetings.

The bottom excavation was handled by two 20-ton traveling derricks, placed side by side in the bottom of the excavation and moving back ahead of the floor. These derricks operated heavy orange-peel buckets, which dumped the excavated material into skips placed on standard flat-cars. The skips were raised from the excavation by means of derricks at the north end, and the material was spoiled over the cofferdam or used as backfill behind the completed portions of the side walls, after the work had progressed thus far. Only sufficient bottom excavation was opened up at a time to

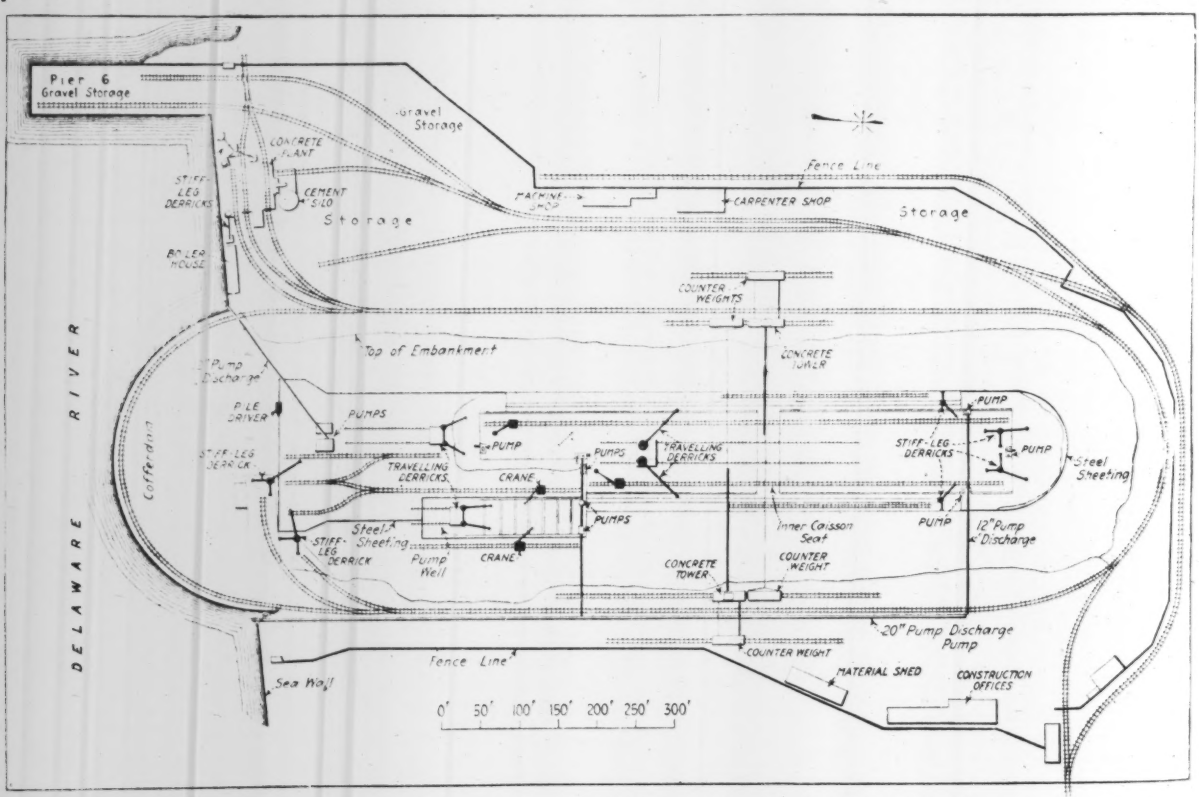
permit the placing of one section of floor between the side-wall foundations, as much material as possible being left inside the sheeting to support the brace piles and to prevent the sheeting from being forced in by the outside earth pressure. The floor was concreted in sections 10 ft. to 30 ft. long and the full width of the dock (116 ft.). As soon as the concrete was set, 12 x 12-in. braces were placed between the concrete and the wales at the top of the sheeting, and the brace piles were removed. The material between the floor and the sheeting was then removed, and the side-wall foundations were concreted, the sheeting being left in.

All the work in the bottom of the excavation has been accomplished only under serious difficulties. Great care had to be exercised to brace securely all of the sheeting to prevent the earth pressure from forcing it in and this naturally interfered, to a considerable extent, with the progress. On account of the hard stratum of cemented gravel and the sand overlying the clay, much of the sheeting was badly deformed when driving. In numerous instances the locking devices failed, and the sheeting would split apart. In other instances, large boulders would deflect the steel and cause it to curl up like a shaving. Wherever these breaks occurred, troublesome leaks developed. The ground outside the sheeting is completely saturated with water, and it was practically impossible to stop the leaks, for if one was plugged the head would build up and a leak break out in a new place. At times as many as six 6-in. centrifugal pumps were necessary to hold the water down in the bottom excavation. Under these conditions the removal of material was very difficult, as well as the placing of the concrete after the excavation was finished.

It is estimated that the amount pumped has varied from 5,000 to over 8,000 gal. per min. One 15-in. one 10-in. and two 8-in. centrifugal pumps have been used for raising the water from the main sumps in the excavation to the surface. Numerous smaller pumps from 6- to 3-in. are used for lifting the water from the deepest portions of the excavation to the main sumps. All of the pumps, from 4- up to 15-in. are motor-driven centrifugals. The 3-in. pumps are driven by gasolene engines and can be quickly moved around from place to place. A 12-in. steam engine driven centrifugal is installed as spare in case of failure of electric power.



EXCAVATING DRY DOCK BOTTOM AHEAD OF HEAVY FLOOR FORMS



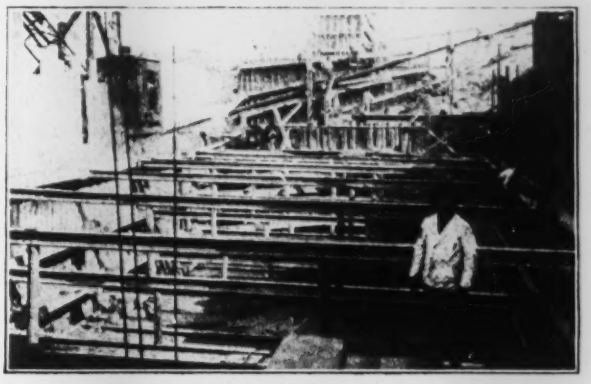
LAYOUT OF CONSTRUCTION PLANT ON PHILADELPHIA NAVY DRY DOCK

The pumpwell of the dock is built integral with it and located in the east side wall several hundred feet in from the entrance. The pumps are located 3 ft. below the floor level, so that they are self-priming, and the motors are placed on the floor at the top of the pumpwell, at elevation — 4.5. On account of the suction chamber underneath the pumps, the deepest portion of the dock foundation is under the pumpwell. This work is being carried on inside of a separate steel sheet cofferdam 214 ft. long and 50 ft. wide. Steel bracing is used inside of this pumpwell to support the sides, the bracing being placed as the excavation proceeds.

The concrete for the floor and walls is mixed in a central mixing plant, located on the river front immediately west of the dock entrance. Gravel and sand are unloaded from barges by two derricks, operating clamshell buckets, and stored in bins directly over the mixer. The bins have capacity for 1300 cu.yd. of gravel and 525 cu.yd. of sand. Gravel and sand are also stored in piles near the mixer plant. The mixing equipment is located directly under the gravel and

SIDE WALLS AND BOTTOM PLACED NEAR SHORE END END OF DRY DOCK

sand bins, and consists of two 2-yd. motor-driven mixers. The cement is received in bulk and is unloaded from the box cars by means of a power-operated shovel or drag, and stored in a silo having a capacity of 2750 bbl. A 775-bbl. cement hopper located above the mixer is kept filled from the silo by means of a belt-and-bucket conveyor. The mixers are placed at a sufficient height to allow for dumping into 2-yd. hoppers, four of which



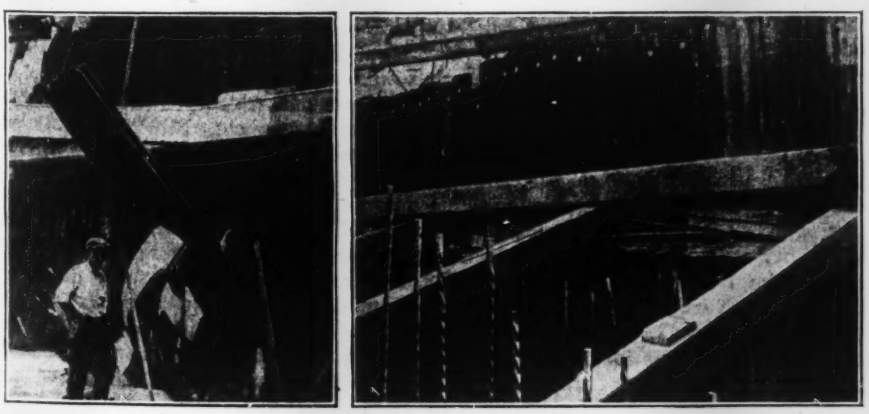
STRUCTURAL STEEL CROSSBRACING IN PUMP WELL COFFERDAM

are placed on standard flat cars, and hauled by 20-ton dinky locomotives. Three concrete cars are so equipped. The concrete tracks completely surround the dock excavation, so that concrete can be placed in any portion of the dock without interference. The concrete is chuted into the lower portions of the dock structure from hoppers placed on the banks just inside of the concrete track. In the higher portions of the dock, concrete is chuted from towers. Two towers are in use, one on each side of the dock, and each consists of a tower built on a standard flat car, and two counterweight cars, with cable supporting the chutes spanning the dock excavation. The tower plants run on tracks parallel to the dock, and can be moved along the dock as required.

As noted above, the floor was placed in large sections 10 to 30 ft. long and usually the full width of the floor, the yardage varying from under 1,000 to slightly over 2,000 cu.yd. per section. The side walls are concreted in 50-ft. lengths, the four lifts varying in depth according to the location of the tunnels in the side walls. The yardage of the side-wall sections varies from 350 in the smallest to about 1300 in the largest section.

The forms are made of wood, with no metal linings. They are constructed in panels of suitable size to be handled by derricks, and are used over and over. The finish of the side walls is obtained by removing the forms when the concrete is still green and rubbing down the surface with carborundum bricks. This gives a very pleasing effect.

After the dredge was removed from the excavation in the early part of 1918, practically no construction work was done for nearly a year, until the revised plans of the dock were submitted by the bureau and the new method of construction was approved. Late in December, 1918, work was resumed under the revised plans, and has continued without interruption since that date. The first concrete was poured in March, 1919, and at the end of August a total of 83,495 cu.yd. was in place. This is an average of nearly 14,000 yd. per month.



WHAT THE HEAVY PRESSURE DOES TO THE SHEETING

The concrete record by months is as follows:

March	6,773 cu.yd.
April	10,924 cu.yd.
May	16,764 cu.yd.
June	20,139 cu.yd.
July	15,744 cu.yd.
August	13,151 cu.yd.

The falling off during the months of July and August was due to the serious troubles with the water and also to the spell of rainy weather which prevailed over this portion of the country during late July and early August. The total amount of concrete to be placed in the dock is approximately 205,000 cubic yards.

The work of placing concrete is continuous throughout the 24 hours of the day; that is, when the concreting of a section is once started the work is carried on continuously until it is finished. The best single day's run has been 1700 cu.yd. April 17, with two mixers and two concrete trains in operation. The speed of placing the concrete is limited by the hauling capacity rather than by the mixing capacity.

The plant for handling this work is unusually complete and includes the following principal items: Three 2-yd. mixers, one as spare; two complete towers for chuting concrete; three 20-ton double-boom traveling derricks; eight stiff-leg derricks, of 15- to 25-ton capacity; seven complete pile-driver leads, with engines; three steam pile hammers; seven locomotive cranes; seven steam locomotives, from 20- to 40-ton weight; one gasoline locomotive, and numerous standard flat cars, and 6-yd. side-dump cars. It is only through the efficient use of the construction plant that such favorable progress has been made on the work.

The entire work of construction of the dry dock is being handled by the Maryland Dredging and Contracting Co. of Baltimore, Md., under the direction of D. L. Taylor, general manager, with J. V. Hogan as resident engineer and D. W. Armstrong as construction superintendent. The contract is being carried out under the supervision of the Bureau of Yards and Docks, of the Navy Department, Rear Admiral C. W. Parks, chief of bureau. Commander A. L. Parsons is the public works officer at the yard, and the writer has direct charge of the work.

Traffic Data On New York State Highways

EVIDENCE of the great increase in motor traffic on New York State Highways during the past 10 yr. was presented at one of the recent public hearings on the New York-New Jersey vehicular tunnel by Frederick Stuart Greene, State Highway Commissioner of New York. Figures covering the period from 1909 to 1919 show motor traffic increases as high as 2,710 per cent in the case of the Albany Post Road at Peekskill, and 2,688 per cent on the same route near Albany. Data were also presented for motor trucks, indicating a maximum increase of 387 per cent in the 3-yr. period from 1916 to 1919, that maximum being noted on the Boston Post Road from Mamaroneck to New Rochelle. Traffic figures were all taken on week days during August, which would indicate that the number of pleasure vehicles tabulated would not be the maximum. The table given above summarizes the information on traffic as observed at six places.

TRAFFIC DATA—N. Y. HIGHWAYS
AUGUST—WEEK DAY—7 A.M. TO 7 P.M.

Location of Highway	Kind of Traffic	Year 1909	Year 1914	Year 1919	Per Cent Increase (+) or Decrease (—)	Motor Trucks 1916	Motor Trucks 1919	Motor Trucks Per Cent Increase (+) or Decrease
Westchester County	Horse	36	.....	34	— 5.5			
Albany Post Road	Motor	99	.....	2,782	+2,710.0			
Peekskill								
	Total	135	.....	2,816	+1,986.0	106	126	+ 18.9
Boston Post Road	Horse	.....	362	85	— 76.0			
Mamaroneck	Motor	.....	2,884	8,121	+ 182.0			
New Rochelle								
	Total	.....	3,246	8,206	+ 152.0	404	1,968	+387.0
Nassau County	Horse	.....	44	25	— 43.2			
Little Neck	Motor	.....	143	919	+ 543.0			
Old Westbury								
	Total	.....	187	944	+ 405.0	43	162	+277.0
Suffolk County	Horse	327	.....	27	— 91.7			
Amityville	Motor	611	.....	1,910	+ 213.0			
Babylon								
	Total	938	.....	1,937	+ 107.0	80	192	+140.0
Rensselaer Co.	Horse	322	.....	56	— 82.6			
Albany Post Road	Motor	125	.....	3,486	+2,688.0			
near Albany								
	Total	477	.....	3,542	+ 643.0	62	232	+274.0
	Horse	1,360	.....	493	— 63.8			
Eight Up-State Roads	Motor	584	.....	11,559	+1,879.0			
	Total	1,944	.....	12,052	+ 520.0	299	986	+230.0

Irrigation in Mesopotamia

The remodeling of irrigation works in Mesopotamia serving some 3,000,000 acres is recommended by A. Burton Buckley, inspector of irrigation in Egypt, in a report entitled "Mesopotamia as a Country for Future Development." Mr. Buckley estimates that the remodeling work would cost about £10 per acre, or a total of £30,000,000, besides which he proposes flood protection works estimated to cost £1,050,000. It is suggested that the expenditure should be spread over a period of some fifty years. The report, which together with a map on a large scale, is reproduced in the London *Engineer* for Feb. 6, 1920, is the outcome of instructions of the British Army Council, issued in December, 1918, to Sir John Hewett, who was directed to go to Mesopotamia and make an examination of expenditures being made in that country by the British Army. Mr. Buckley was selected to make the investigation covered by the report mentioned. (*Cairo*: The Government Press. Price P T 5.)

Brush Coat Should Follow Trimming of Treated Timber

By George M. Hunt
In Charge of Wood Preservation, Forest Products Laboratory.

THE necessity of protecting treated timber after trimming is demonstrated in the three accompanying photographs of a treated pile end, upon which two fruiting bodies of the fungus *Lenzites sepiaria* are growing. This fungus is one of the most serious enemies of coniferous structural timber in the United States and is responsible for a great deal of the decay which takes place in pine timbers.

At first glance, it would appear that the creosote treatment had failed to prevent decay. An examination of Figs. 2 and 3, however, will explain the apparent paradox. In Fig. 2 a slice has been sawed from one-half of the face of the section to show clearly the dividing line between treated and untreated wood. This

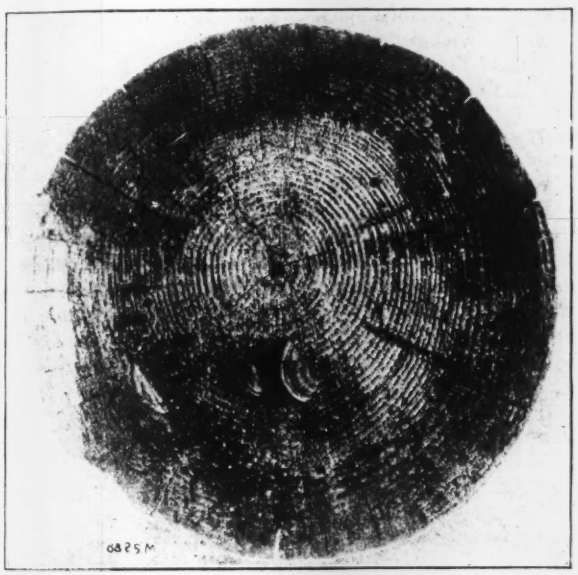


FIG. 1. END OF PILE, SHOWING FRUITING BODIES OF FUNGUS

indicates that a good penetration of oil was secured, but that the center of the pile is untreated. It is quite evident from this photograph that the fungus is growing within the untreated area. In Fig. 3 the section has been split between the two fruiting bodies, to show more clearly that they are growing on the untreated area. The wood immediately beneath the fungus was noticeably decayed and discolored.

The pile originally received a good treatment. Subsequently a section was cut off the end of the pile inside the area of complete penetration which is found at the end of a treated stick, thus exposing untreated wood. The pile was then exposed to the weather for some time. During this weathering period the end of the pile became disclosed, and the fungus developed. It is possible that there was slight decay in the pile before it was treated and that cutting off the end merely allowed the fungus to fruit. It is also possible that the timber was perfectly sound in the beginning and that the fungus got into it after the untreated wood was exposed. In either case, after the end of the pile was trimmed, it should have been given

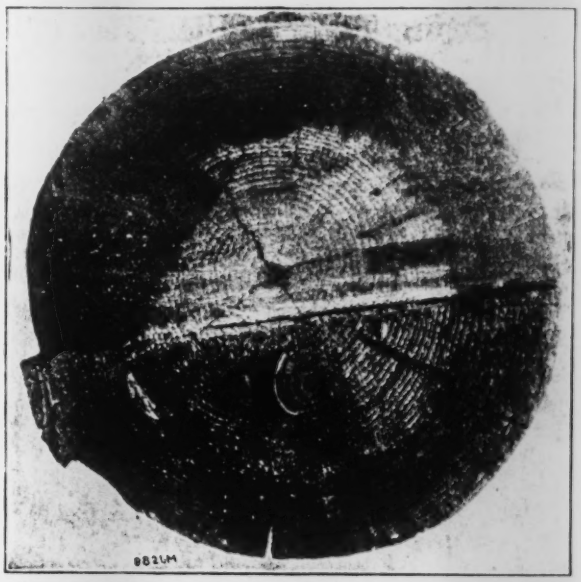


FIG. 2. A SLICE HAS BEEN CUT FROM ONE-HALF THE SECTION TO SHOW THE UNTREATED AREA

two or three thorough coats of hot creosote. This treatment would probably have retarded the growth of the fungus if it were already in the wood, but it could not have been depended upon to kill it entirely. If the wood were sound when cut, the coating would have prevented subsequent infection.

It is axiomatic in wood preservation that the untreated parts of a creosoted stick which have been exposed by cutting after treatment should be protected at once by brushing thoroughly with preservative, that treating wood which contains decay cannot be relied upon to stop the decay.

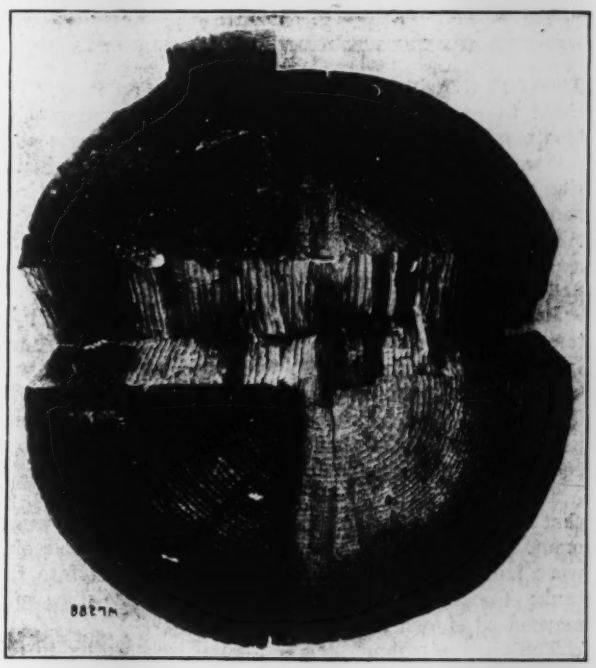
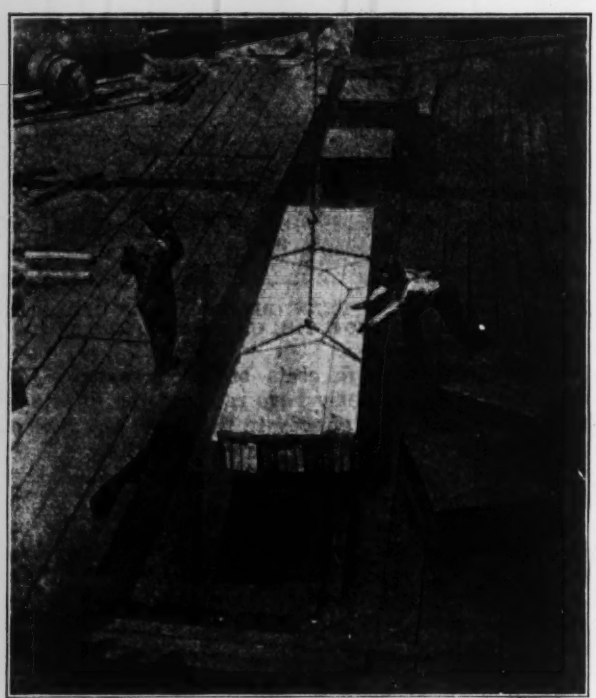


FIG. 3. BLOCK SPLIT TO SHOW THE FUNGUS WELL WITHIN THE UNTREATED AREA

Treating Three Million Feet of Lumber on the Job

High Bids for Creosoting Rejected—Open-Tank Methods Employed on Pier at Seattle, Wash.

A new pier, known as Pier B, is being constructed by the Port of Seattle in Smith's Cove. It is 2,560 ft. long by 365 ft. wide, and exclusive of sheds, requires in its construction 9,500,000 ft. b.m. of lumber. Of this total,



WEIGHTS ARE USED TO KEEP THE LUMBER SUBMERGED

3,000,000 ft. will be subject to dry rot, and it was decided to give this timber some form of preservative treatment. The best figure submitted by creosoting companies was $56 per 1,000 ft. b.m. Since this quotation was considered excessive by the port officials, arrangements were made with the general contractor to treat the timber after it came on the job. The treatment has been carried out satisfactorily at a cost of $16 per 1,000 ft. b.m.

It was decided to use "Carbosota" creosote oil at temperatures between 245 and 360 deg. Fahr. A sheet-iron tank 3 ft. deep, 4 ft. wide and 50 ft. long was placed so that it could be served conveniently by a stiff-leg derrick. The tank was heated by steam coils. Temperatures were taken by a thermometer fastened to a rod which the foreman thrust into the tank occasionally.

The lumber was piled with strips between layers, so that it would season as much as possible before treatment. When ready for treatment piles of suitable size were laid under the derrick boom and swung into the tank. Concrete blocks were used to keep the piles submerged as shown in the illustration.

The time of submersion was varied according to the size of the timbers and the amount of seasoning. For 3 x 12-in. sheet piling the submersion was 20 to 30 minutes. For some of the larger comparatively green timbers submersion as long as two hours occasionally was given. The length of time in the tank was determined by an inspector representing the Port of Seattle. Both timber and lumber were framed before treatment. Where there was abrasion or other damage to pieces after treatment, the contractor was required to paint these places with two coats of hot creosote oil.

The timber and lumber which specifications required to be treated included ties, bulkhead lagging, pile caps, floor sleepers, waling, bracing and all timbers used in the piers below the floor level except floor planking, floor stringers and piles. The piles were treated before coming on the job. In addition to treatment of entire pieces, two coats of the hot creosote oil were applied to all surfaces where wood rested against wood. Tests with a boring machine to determine penetration indicated a range in depth of from $\frac{1}{8}$ to $\frac{1}{4}$ in. The absorption per thousand feet board measure in timber was 11 gal. and in lumber 17 gal. After submersion the lumber was suspended above the tank for draining.

G. F. Nicholson is chief engineer of the Port of Seattle. The general contract on Pier B is held by the Harrington-Peters Co. of Seattle.

Federal Engineers' Salary Increases as Reported Out to Congress

Proposed salary increases for engineers in government service have been reported out to Congress by a joint Congressional Committee of which Senator Jones of New Mexico is chairman. After a thorough investigation of the salary classification the committee recommended substantial increases as follows, a range being given in each case with four or five increments:

Assistant highway engineer	$2400 to $3000
Associate highway engineer	3240 to 3840
Highway engineer	4140 to 5040
Assistant hydraulic engineer	2400 to 3000
Associate hydraulic engineer	3240 to 3840
Hydraulic engineer	4140 to 5040
Assistant hydrographic and geodetic engineer	2400 to 3000
Associate hydrographic and geodetic engineer	3240 to 3840
Hydrographic and geodetic engineer	4140 to 5040
Landscape draftsman	1200 to 1800
Junior landscape architect	1800 to 2160
Assistant landscape architect	2400 to 3000
Associate landscape architect	3240 to 3840
Landscape architect	4140 to 5040
Assistant structural engineer	2400 to 3000
Associate structural engineer	3240 to 3840
Structural engineer	4140 to 5040
Assistant topographic engineer	2400 to 3000
Associate topographic engineer	3240 to 3840
Topographic engineer	4140 to 5040
Civil engineering draftsman and civil engineering aid	1200 to 1800
Junior civil engineer	1800 to 2160
Assistant civil engineer	2400 to 3000
Associate civil engineer	3240 to 3840
Civil engineer	4140 to 5040
Cartographic draftsman	1200 to 1800
Assistant cartographic engineer	2400 to 3000
Associate cartographic engineer	3240 to 3840
Cartographic engineer	4140 to 5040

For most of the higher positions the rate is to be recommended to Congress by the Civil Service Commission after consultation with heads of departments or independent establishments concerned.

Filtros Plates Successfully Cleaned

Operations for the removal of iron rust from filtros plates in one of the activated-sludge plants for the treatment of the sewage of Houston, Texas, have proved successful. We learn from G. L. Fugate, principal assistant city engineer in charge of sewage treatment, that up to March 9 about 2,100 plates had been cleaned by immersing them in hydrochloric acid at 98 deg. C. (See *Engineering News-Record*, Dec. 11-18, 1919, p. 1003).

Dilution Requirements of Sewage and Sewage Effluents

By C. B. Hoover and C. D. McGuire
Chemist in Charge Assistant Chemist
Division of Sewage Disposal Columbus, Ohio

It has long been recognized that any determination of what constitutes a permissible pollution of a stream should be based on the present and probable future uses of the stream below the point of discharge, the present and probable future values of riparian land values below the point of discharge, the present and probable density of population adjacent to the stream below the point of discharge, and the stream flow and temperature factors, especially during the summer months of the year. The economic, esthetic, and health problems involved in stream pollution ordinarily do not exist separately, although any one of the three phases may be dominant in particular cases. The economic and esthetic phases of this problem are dominant in the problem at Columbus, Ohio, and during the year 1919 laboratory studies have been conducted with the idea of getting an approximate estimate of the dilution requirements of our untreated sewage and of the effluents from two-story tanks and sprinkling filters.

The stability test, when conducted in bottles with tightly fitting glass stoppers, is an exacting determination of the dilution requirements inasmuch as no opportunity exists for the absorption of oxygen from the air and in this respect it differs from the condition existing in a stream where the replenishing of used stream-water oxygen takes place by absorption of oxygen from the air. Dilution requirements determined in this way may be regarded as conservative. If the stability test, properly conducted, is not a reliable index of the dilution requirements of untreated and treated sewage, then these results are of little value and the use of this test by sewage-works operators is a waste of time. We believe that the stability test will give a reliable approximation of dilution requirements *when properly conducted.*

The characteristics of the sewage and of the effluents from the tanks and the filters are shown by the accompanying table, as are also the percentage results obtained by the tanks and the filters, and the dilution requirements for crude sewage, tank and filter effluents.

Selecting the value 98.7 per cent in column A of the stability section of the table, interpolating in column B to get the same value, and taking the given value of 98.7 per cent in column C, we find that the diluting water required in second-feet per thousand population, and with which 98.7 per cent of the samples were stable, is as follows: For untreated sewage, 5; tank effluent, 2.70; sprinkler effluent, 0.20. Whether the dilution should be fixed at a value which would ensure stability for 100 per cent of the samples, or in other words which would ensure stability for the sewage of maximum strength, or, whether a somewhat lower dilution value should be selected, is a matter of judgment with whomever has such a decision to make.

The practical agreement in percentages of reduction of oxygen demand and dilution requirement by tank treatment is due to the fact that there are negligible quantities of nitrites and nitrates in the crude sewage and tank effluents and consequently only dissolved oxygen is available for stabilizing the samples. The disagreement between the reduction in oxygen demand and dilution requirement by the sprinkler treatment is due to the fact that the nitrites and nitrates present in the sprinkler effluents are sources of oxygen and that this oxygen supply is not drawn upon in the oxygen demand test, but is drawn upon in the methylene blue test. In the oxygen demand test the depletion of oxygen is not carried to the point where the oxygen supply of the nitrites and nitrates is drawn upon. This test runs for a period of 24 hours and only approximately 50 per cent of the dissolved oxygen is consumed and with a good supply of dissolved oxygen available the reduction of the nitrites and nitrates does not take place.

CHARACTERISTICS AND DILUTION REQUIREMENTS OF SEWAGE AND EFFLUENTS, COLUMBUS, OHIO
Based on 150 daily composite samples of crude sewage, two-story tank effluent and sprinkling filter effluent collected during 1919

CHARACTERISTICS OF COMPOSITE SAMPLES

	Total Suspended Matter P.P.M.			Dissolved Oxygen Consumed After 24 Hrs., at 37° C., P.P.M.			Stability Values			Diluting Water Required for Stability, Sec.-Ft., per 1,000 Population		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min	Mean	Max	Min.	Mean
Crude sewage	500	80	221	288	48	181	10 0	2 5	7 2	6 04	1 39	2 000
Two-story tank effluent	190	35	94	240	48	135	17 8	5 0	9 6	2 94	0 72	1 460
Sprinkler effluent	220	15	72	68	12	27	100	39	73	0 24	0 00	0 057

PERCENTAGES OF REDUCTION

	Suspended Solids	Oxygen Demand	Dilution Requirement
By two-story tank treatment	57 5	25 4	27 0
By sprinkling filter treatment	23 4	80 0	96 1
By both treatments	67 4	85 1	97 1

DILUTION REQUIREMENTS

Diluting Water, Sec.-Ft. per 1,000 Population	Equivalent Stability Values	Per Cent of 150 Samples That Were Stable After Incubation 9 Days at 37° C. A. Crude Sewage	B. Two-story Tank Effluent	C. Sprinkler Effluent
6 0	2 5	100 0	100 0	100 0
5 0	3 0	98 7	100 0	100 0
4 0	3 7	92 7	100 0	100 0
3 0	4 9	76 7	100 0	100 0
2 0	7 2	52 0	87 3	100 0
1 5	9 4	38 7	72 0	100 0
1 0	13 3	0 0†	2 0†	100 0
0 5	24 0	.....	.....	100 0
0 4	28 0	.....	.....	100 0
0 3	34 0	.....	.....	100 0
0 2	44 0	.....	.....	98 7
0 1	61 0	.....	.....	59 3†

† The table at these points is weak because in many cases the lowest dilution was stable, thus leaving in doubt the exact stability value of the sample

Should Juniors Vote?

Question has been raised by the Philadelphia Section of the American Society of Mechanical Engineers as the right of the Juniors in that society to vote. It has passed resolutions calling upon the society to change its constitution so that Juniors would be allowed to vote and to hold office. The reason apparently is that in our political life men become of age and are allowed to participate in all of the privileges and must bear all of the responsibilities of citizenship at the age of twenty-one. It is pointed out, too, that in medicine, law, and architecture, practitioners are allowed to assume all of the obligations under the law at that age.

Half a Century of Constructive Engineering Service

An Appreciation of John D. Isaacs

FOR half a century John D. Isaacs, consulting engineer of the Southern Pacific Company, has been engaged in a broad field of engineering work requiring unusual versatility. He is pre-eminently a constructive critic and as such has exerted his greatest influence on the development of railroad engineering in this country. Affiliated with the builders of the Southern Pacific since the days of its infancy he achieved success through unqualified loyalty to the company and untiring energy in carrying out the great programs of standardization instituted by its general officers. He has not confined his talents to any single field of activity, but has successfully applied himself to the solution of a vast number of the perplexing engineering problems which were encountered during the building of a great railroad system, from the days when scarcity of finished materials imposed extraordinary difficulties in design and construction. As an inventor, a resourceful experimenter, an accomplished structural designer and architect, and an expert on track and maintenance of way, he has made many notable contributions to the advancement of railroad engineering, reflected not only in their direct results, but also in their influence upon other men. Not a few of the present officers of the Southern Pacific received their early training under Mr. Isaacs, and many have remarked upon his eagerness to give due credit to his subordinates. Keeping personal considerations ever in the background, his primary purpose has always been to seek out the best talent for the company.

Consulting Engineer of Southern Pacific in Service of Company for Forty-Five Years

JOHN D. ISAACS

It seems appropriate at this time to record a few of his contributions to science and engineering. Among the inventions in which he shared may be mentioned the portable wood-preserving plant, the taper rail, the rifled oil pipe line, and the first apparatus which successfully produced what were, in effect, motion pictures. In research and experimentation, his work is notable particularly in the study of steel rails and in wood preserving. His brilliant contributions to the studies of tonnage rating and traction have had a profound effect on the development of successful operation of freight trains of large units. Mr. Isaacs was born Oct. 6, 1848, at Richmond, Va. He was educated at the University of Virginia, in the scientific course, which in those days was closely associated with the Department of Liberal Arts. His early practical training was as a machinist apprentice in Baltimore, Md., and Wilmington, Del. In 1875 he went to San Francisco and entered the service of the lines now comprising the Southern Pacific Railroad, as a draftsman in the maintenance of way department. His progress was rapid, and it was not long before he was made chief draftsman and later assistant superintendent of bridges and buildings. In 1890 he became acting superintendent of bridges and buildings and a year later, assistant engineer maintenance of way of the Pacific System of the Southern Pacific Co. and Lines in Oregon. Immediately following the launching of the project, by J. Kruttschnitt (then director of Maintenance and Operation, Southern Pacific Company and Union Pacific System) to establish standards common to all the Associated Railroads—"Common Standards"—at the Chicago meeting of the Harriman engineers in 1905, Mr. Isaacs was appointed consulting engineer of Southern Pacific Co. and the Union Pacific System, becoming the consulting engineer for all of the Harriman Lines and their subsidiaries. After the dissolution of the Harriman property in 1913, he was retained as consulting engineer of the Southern Pacific Co., and still occupies that position.

In the early seventies the late Senator Stanford, who was one of Mr. Isaacs' closest friends and who often

sought his advice in mechanical problems, made a bet of $25,000 with James W. Keene that a trotter at one period of the stride had all four feet off the earth at once. Historically, this bet marked the birth of the motion picture. It was decided to use a number of cameras, set side by side, to make an accurate photographic record of a trotting horse. After several devices for mechanically operating the shutters of the cameras had failed, Mr. Isaacs was called in and finally devised a simple electromagnetic release, which successfully recorded a series of photographs, settling the bet in favor of Senator Stanford. A considerable sum of money was spent on these experiments and it was not until 1878 that they were concluded.

Inventions

The steady drain on the great timber resources of the Pacific Coast threatened eventually to denude the forests and attention was turned to the study of wood-preservation. Being one of the foremost designers of wooden structures, and having worked out plans making possible the construction of wooden trusses and drawbridges of long span, it was quite natural that Mr. Isaacs should become prominent in the study of wood preservation. His appointment to complete charge of the wood preservation work of the Southern Pacific was one of his first assignments as consulting engineer. He is generally recognized as one of the ablest authorities on wood preservation in the United States, having won this distinction by his active work in the practical development of the creosoting and Burnettizing processes, now so extensively used. His joint invention with W. G. Curtis of the portable wood preserving plant, immediately after he was appointed second assistant engineer maintenance of way in 1892, marks one of the greatest advances in the industry. One has only to examine the maintenance records of the railroads which treat ties to realize the importance of this work.

The Taper Rail devised by Mr. Isaacs to connect two abutting rails of different section has been very widely used. This simple device, now well known to all track men, consists merely of a piece of rail from 8 to 16 feet long so forged that the ends correspond respectively to the two sections to be joined, permitting the use of ordinary joint bars without the annoyance experienced in the connection of rail by so-called compromise joints.

The Rifled Pipe Line, invented jointly by Mr. Isaacs and J. B. Speed in 1905, afforded a temporary solution for what seemed at first to be impossible. Some of the heavy California oils could not be transported in pipes without expensive preheating, on account of the frictional losses in head. Mr. Isaacs and his assistant conceived the idea of rifling the pipe like a gun bore, to give the oil a whirling motion. Then, when pressure was applied water (introduced as a lubricant) mixed with the oil and being somewhat heavier would be thrown by centrifugal force against the pipe surface and maintained there as a thin film, thus permitting much easier passage for long-distance pumping. This use of water as a lubricant appeared to make it impossible for a crude oil to stick to the pipe and impede its progress. After exhaustive preliminary tests, an experimental rifled pipe line was constructed between Delano and Volcan, a distance of 31 miles. The results were good enough to warrant the laying of the 282-mi. line of 8-in. rifled pipe from Delano in the Kern River oil fields to tidewater at Port Costa.

In 1899 J. Kruttschnitt, then general manager of the Southern Pacific Company, appointed committees of engineering officers of the maintenance and mechanical departments to prepare a uniform and consistent system of locomotive tonnage rating on all disivions of the company's lines. The paper on tonnage rating, written by W. G. Curtis, engineer maintenance of way, with the able assistance of Mr. Isaacs, is an outgrowth of this work which has attracted wide attention. After the study of detailed line profiles and extensive mathematical analyses, here was developed a theoretical basis for rating the tonnage to be handled over a division by a given class of locomotives at the required speed according to the time tables for the trains—a matter of the greatest importance on a busy section of single track. In 1909 the first paper was supplemented by another—"Most Efficient Speed for Freight Trains," prepared jointly by Mr. Isaacs and his assistant, E. E. Adams, now consulting engineer of the Union Pacific System.

The Harriman "Common Standards"

Immediately before his appointment as consulting engineer, Mr. Isaccs attended a Chicago meeting of Union and Southern Pacific engineers, which was called in 1905 by Mr. Kruttschnitt to establish standards for way and structures common to all of these lines. He had with him plans of the standards then in force on the Pacific System of the Southern Pacific Company, and was thoroughly familiar with all their advantages, having been in charge of the actual preparation of many of the drawings. He presented them in a forceful way and they were adopted as "Common Standards." Not only was this a great personal triumph; the adoption by the company of the policy to establish "Common Standards" was successfully worked out by Mr. Isaacs in collaboration with the other engineers of the Maintenance of Way Department of the Union and Southern Pacific Systems, and has contributed to the splendid appearance and systematic neatness of the properties for thousands of miles. These results were obtained through the scientific standardization of track and structures and the rigid policing of right of way and structures by operating and maintenance forces.

The classic series of Common Standard Bridges from 30 ft. to 200 ft. span, varying by 10 ft., both single and double track, were designed by Mr. Isaacs and have stood the test of 16 years of service and have been rewarded by generous praise of bridge manufacturers. There has been a considerable saving on the cost price of every standard bridge ordered, accounted for by the saving in drawings and templets. Fully as great, perhaps, as the monetary saving is the avoidance of untold discussion by this definite bridge policy. There are no arguments necessary regarding the type, depth and the many petty details which ordinarily harass the management on every new bridge project.

Among the first of a long series of important designs made by Mr. Isaacs, was the large car transfer steamer Solano, operated for many years across the Straits of Carquinez, between Benicia and Port Costa, Cal., where the great rise and fall in tide necessitated the use of unusually long ferry aprons. When he was chief draftsman in 1876, Mr. Isaacs designed and drafted, himself, the plans for all the timber trussing for the Solano, as well as the 100-ft. span aprons and machinery, including hinges and pontoons to carry the rolling trainloads from the shore to the steamer deck. This was considered a

remarkable accomplishment at the time, as there was no precedent for aprons of such span and loading.

Important Bridges and Stations

Important structures built under Mr. Isaacs' direction are too numerous to mention and only a few of the most notable can be recorded here. The double deck and track Sacramento River drawbridge is said to be one of the heaviest ever built. Other examples of his work are the Coos Bay drawbridge, 458 ft. long; the reinforcement of the Pecos River viaduct, 1,516 ft. long and 320 ft. above the river bed, with practically no interruption to traffic; the lift bridge over the Willamette River, Portland, Ore., and the Berwick drawbridge over the Atchafalaya River, La., involving the deepest caisson work ever attempted for bridge piers. His work has been notable in the design of general layouts for passenger terminals, freight car classification yards, and railroad shops. More recent work of this character includes the Galveston Freight Terminal and Grain Elevator; Marine Ways at Alameda, Cal.; Empalme Shops, Mexico; and the Pacific Electric Shops and Yards at Torrance, Cal. He has a fine sense of the esthetic features of design and is a proficient student in the architectural forms. Many have remarked upon the characteristic beauty of his passenger stations, and he should be accorded full credit for those at San Antonio, Tex., and Spokane, Wash.

Mr. Isaacs has always favored experiments to try out the value of new devices, with the result that the Southern Pacific has been a leader in the use of many important improvements. He is keen to observe flaws in bad schemes, but is always willing to accept for trial any device which appears to have merit. He played an important role in the experiments which led to the installation, by the management,, of the large mileage of automatic block signals on the Southern Pacific Lines. The lessons to be drawn from train accidents have been thoroughly appreciated by Mr. Isaacs and he has displayed great acuteness in the analysis of causes, recommending revision or improvement of that part of track or rolling stock which appeared to contribute directly or indirectly to the accident.

Probably his most important work in the promotion of greater safety in railroad practice has been in the study of steel rail, and the resulting revision of specifications and inspection methods. Recognizing his intimate knowledge of the practical side of the perplexing rail situation, the American Railway Engineering Association conferred upon Mr. Isaacs the honor of the chairmanship of its Rail Committee for many years. Taking up this important subject in 1906 he started a vigorous campaign to reduce the number of rail failures on the Associated Lines.

This work, so vital to safety, with the high speeds and tremendous moving masses attending modern railroad operation, has been rewarded with most gratifying results. In a recent annual report of the Southern Pacific Company there appears the following statement by J. Kruttschnitt, chairman of the Executive Committee "By the exercising of greater care in inspecting and purchasing, the failures of rails per 100 miles of track, equated as to traffic borne, have fallen 85 per cent in eight years and in number are but one-fourth as many as those on all railroads in the United States and Canada, based on the latest available data." This may generally be attributed to the policy of the management and to Mr. Isaacs' work in bringing about changes in sections and specifications, and to the establishment of a special system of inspection, and his ingenious and original work in the compilation of statistics, including each rail failure on the entire system. The standard A. R. A., Series A, and R. E. Sections of the American Railway Engineering Association, which have come into such general use, were suggested by Mr. Isaacs and he supported them with conclusions drawn from the Southern Pacific failed rail statistics, which are considered by many the most comprehensive data on this subject in existence.

The diversity of work herein recorded emphasizes the fact that Mr. Isaacs has not confined himself entirely to the field of civil engineering. On many occasions his advice has been sought in the design of rolling stock and in mechanical problems. In the preparation and revision of the designs of the Southern Pacific standard equipment, Mr. Isaacs has worked jointly with F. W. Mahl, director of purchases and mechanical engineer, and with him worked up the design which was the basis for the Southern Pacific's suggestions for a standard single-sheathed box car, recently submitted to the American Railroad Association, though at the present writing it has not been adopted. The retention of a 200-lb. boiler pressure for superheated steam locomotives, a much disputed point, was recommended by Mr. Isaacs and finally ordered.

For the past seven years he has had charge of the centralized plan of inspection, established by the Harriman Lines in 1912. This system, under which $10,000,000 worth of materials annually were subjected to inspection, was instituted by Mr. Isaacs and has resulted in considerable economies as well as a marked improvement in uniformity of materials.

An Arbiter of Contract Disputes

As a committee of one on arbitration of disputes between contractors and the Company, Mr. Isaacs enjoys an enviable reputation. The story is told of a contractor who once refused to pay a claim for repairs to a recently finished job. Litigation was threatened, but the contractor finally said: "Let us lay the whole matter before Mr. Isaacs; whatever he decides I am sure will be fair and right, and as far as we are concerned will be final." This is but an incident illustrative of the esteem in which he is held by large contractors who have been engaged in work for the railroad company.

Up to the time of Federal control, the Southern Pacific made contracts covering its larger requirements of certain standard materials, which were in the form of agreements between the Director of Purchases and the manufacturer. There were some contracts in which Mr. Isaacs was named as sole authority in cases of dispute as to the classification of materials, and there are no complaints on record of his ever using this absolute authority to impose unfair burdens.

Though a man of high professional attainment, Mr. Isaacs' life has been one of simplicity. Naturally of a retiring disposition, he has never sought the public eye. Always preferring the quiet satisfaction of a small circle of friends to the excitement of public gatherings, it has never been his custom regularly to attend the meetings of technical societies, except when his influence might be needed for the success of some important measure.

Design and Operation of Modern Car-Dump Coal Pier

Development of Plans by Jersey Central Railroad—Steep Run-Off Grades Successful—Reinforced Concrete Girder Trestles Found More Economical Than Steel

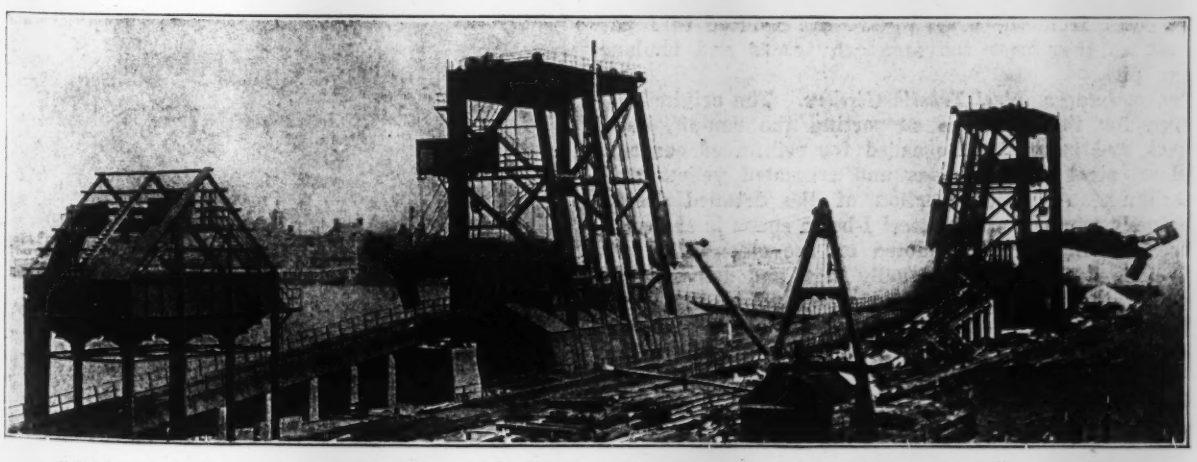
BUILT to handle 400 cars per day, the recently completed coal pier of the Central Railroad of New Jersey at the Jersey City terminal, equipped with two independently operated car-dumpers, is the result of an exhaustive study of several general plans and careful analysis of special conditions which were met by a radical revision of a detailed plan. Consideration of gravity type wooden and steel piers preceded the adoption of the final plan for car-dumpers, and steel trestle construction was abandoned in favor of reinforced concrete after study of design and costs. The run-off grades, among the steepest ever used, were determined upon to facilitate operation and somewhat by restricted space. The design finally adopted is thought to represent the most modern of any similar installation yet constructed.

A series of yards a mile long, two reinforced-concrete thawing sheds with separate gravity yards, a power plant of 2,000-hp. capacity, in addition to the pier and dumper units, were built to form the complete plant, which will be the largest water-front coaling station in New York Harbor when twenty-one pairs of circular tug coaling pockets of reinforced concrete, extending from the present end of the pier, are built. The yard layout consists of a receiving yard, a classification yard divided into two parallel units (due to restriction of space) and a loaded advance yard to serve two gravity yards, each of which independently serves a dumping unit including thawing shed. The power house, including an electric substation, is located on the shore adjacent to the pier at the south side and supplies steam power, compressed air and electric current for operating dumpers and thawing houses. Electric power is brought in from the railroad company's main power plant at Communipaw, about a mile distant from the new coaling plant, on a 2200-volt a.c. transmission line.

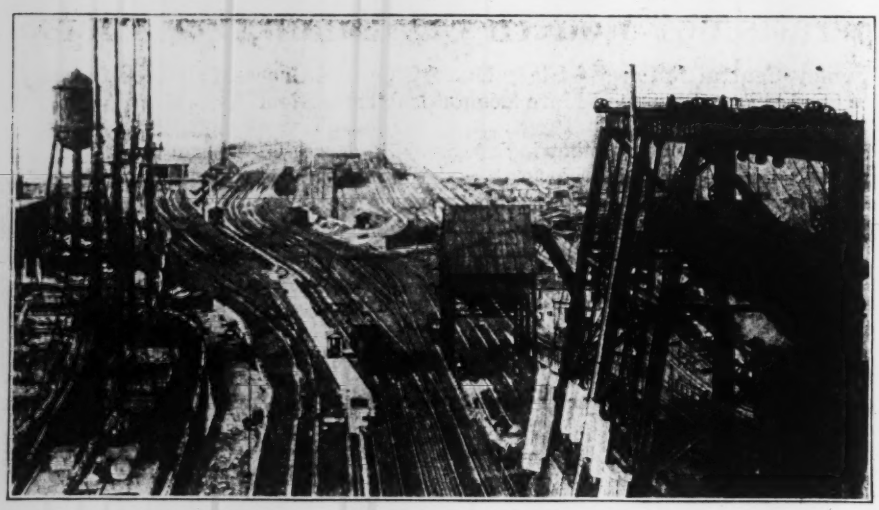
Side elevations and a plan of the pier, together with details of reinforced concrete girder trestle construction, are shown in the accompanying inset. A general view of the pier and the two dumpers, when nearing completion, is shown below. A view of the thawing sheds with depressed return tracks between the north and south gravity yards, as seen from the top of the outshore dumping tower, appears on the next page. The new pier was built to handle new business together with that previously cared for by two old wooden gravity piers, which were also used for tug coaling.

Selecting the Type of Plant. When the need for additional facilities became apparent, two new wooden gravity piers were at first considered. After brief consideration this plan was abandoned in favor of a single wooden or steel gravity pier of much larger size and capacity. Later, a direct dumper type of pier was finally adopted for the following reasons: (a) Minimum cost per ton of coal handled; (b) maximum capacity per foot of water front used; (c) practical elimination of fire risk; (d) economy in labor; (e) permitted of maximum development of area available for approach and classification yards, which was limited; (f) less breakage of coal due to handling in bulk and also due to adjustable height of discharge; (g) type of cars used not restricted to hopper bottom cars; (h) concentration of loading operations at a fixed point on the piers requires the minimum of classification of cars in the yard.

Development of General Design. After it was decided to use two car dumpers, the layout of tracks and trestles on the pier was largely determined by the desire to secure the narrowest pier width consistent with proper limits of clearance, curvature and grades. The length of the pier, which will be 1,584 ft. from bulkhead line when the tug coaling pockets are completed, was determined by the War Department's pierhead limits with respect to the Jersey shore and Ellis Island. Minimum width of pier was determined by width required for dumpers plus necessary clearances of parallel return tracks and dumper towers. Additional space for handling boats in the slip at the north of the pier site made it possible to locate dumper No. 1 only 300 ft. from the bulkhead line, while it was necessary to locate dumper No. 2 further outshore, since it was not practicable to construct a slip on the south



NEW COAL PIER OF CENTRAL RAILROAD OF NEW JERSEY HAS TWO INDEPENDENT CAR DUMPERS



THAWING SHEDS FROM TOP OF NO. 2 DUMPER—DEPRESSED RETURN TRACKS PASS UNDER SOUTH GRAVITY YARD APPROACH

side. The exact distance between the dumpers was determined as the minimum distance with 12°30′ curves and 13-ft. centers between parallel return tracks, adopted to obtain minimum pier width. Since height of tracks at dumpers was practically fixed, lengths of run-off and kick-back trestles were determined largely by elevation of and distance to return tracks at bulkhead line, as well as desired grades to facilitate operation.

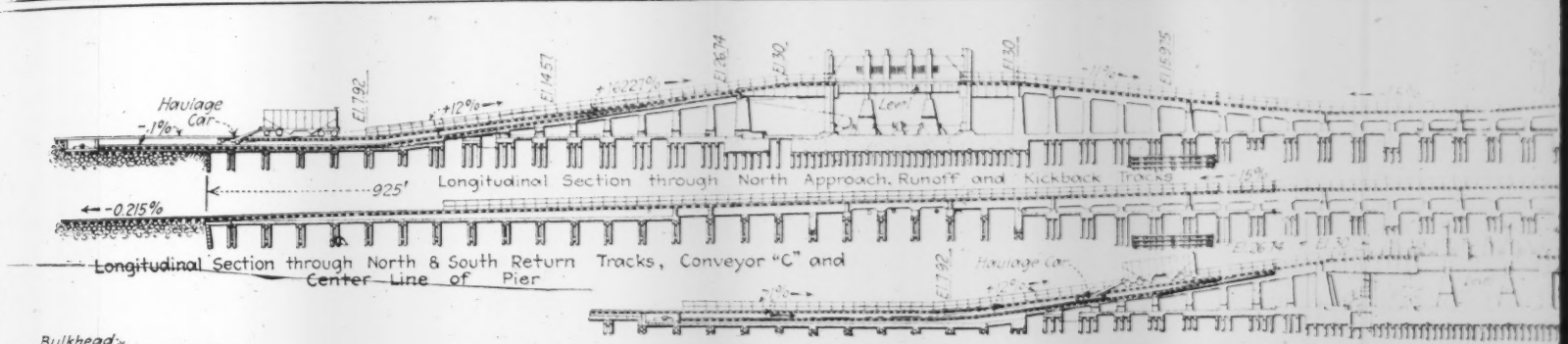
From an operating standpoint a run-off grade of at least 8 per cent was considered desirable, and this was adopted for No. 2 dumper. To simplify the construction of trestle piers it was almost imperative that the return-track grade from kick-back, No. 1 dumper, should reach the same elevation as return track for No. 2 dumper, between stations 5 and 6, as shown in profile included in the accompanying inset. To reach this level in the shorter distance, a grade of 11 per cent was required for the run-off track of dumper No. 1. The danger of cars "getting away" on such a steep grade was considered, but it has been successfully operated without accident. Grades of 12 per cent are used on the approaches (under operation by haulage car); for kick-back tracks, grades of 18 per cent, and for return tracks, a grade of 1.5 per cent. Grades of 1½ per cent from the gravity yard are reduced to 1 per cent as they near the approach tracks and haulage car pits.

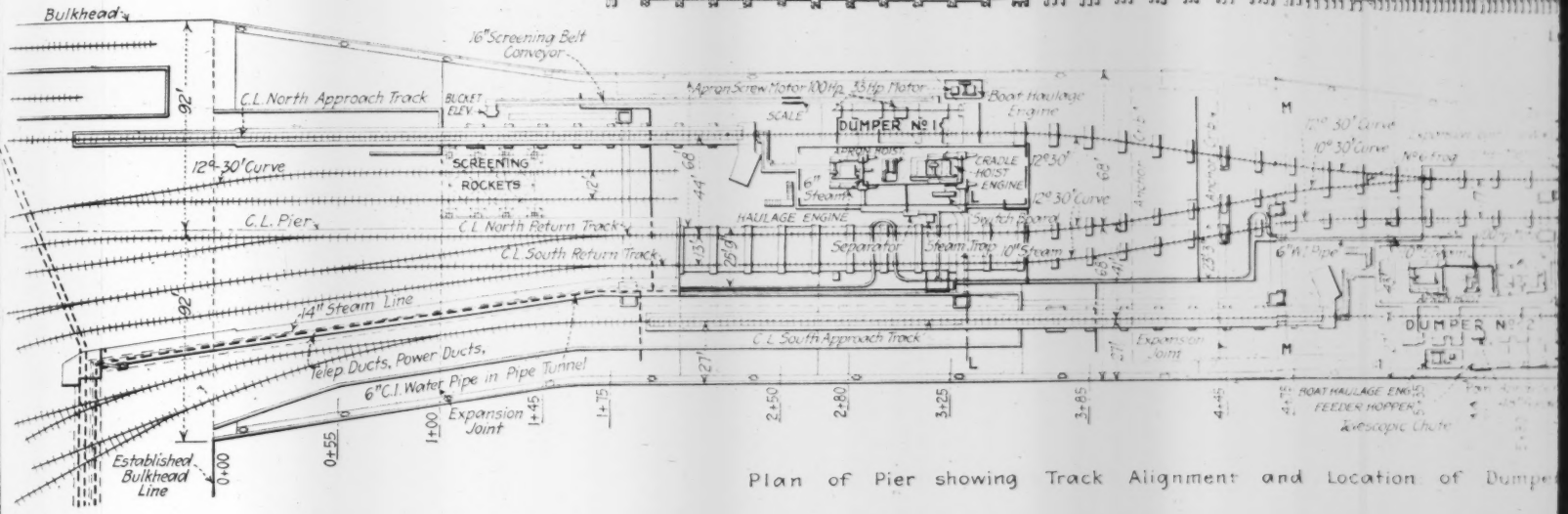
Concrete vs. Steel Trestle Girders. The original design for the structure supporting the run-off, kick-back and return tracks called for reinforced concrete piers, steel I-beam spans and creosoted yellow pine decking. A typical portion of the detailed design actually worked out for steel I-beam spans is shown in the drawing. Prices quoted on the steel called for by this design were unusually high and delivery was uncertain due to the enormous demand at that time. Therefore, an investigation of costs, advantages and disadvantages of substituting all concrete construction was made, which led to the adoption of present concrete girder spans, with the following considerations: (1) Excessive cost of form work for building monolithic concrete girders excluded this type of construction; (2) concrete track slab at shore end of pier offered ideal site for a casting yard to reduce handling charges to minimum; (3) preliminary design of precast concrete girder, together with estimate of cost, indicated that initial cost of concrete construction would be less than that for steel, and (4) it was unnecessary to figure and compare annual costs since concrete construction obviously would involve no maintenance charges, whereas steel-work would be subject to more than the normal maintenance and depreciation due to the action of coal dust and salt water.

Therefore, the unusual conditions in the steel market which developed after the original design for steel girders was completed caused the steel design to be abandoned in favor of pre-cast concrete. New detailed plans of reinforced concrete girders of the pre-cast type were made. A record of unit costs kept during construction indicated a net saving of 10 per cent in first cost in favor of concrete. In addition to the saving in original cost, maintenance and depreciation, the type of girder adopted resulted in a decrease of about 2 ft. 8 in. in the necessary height of all supporting concrete piers, one foot being gained by building girders with haunches at the ends. Also, the actual cost of concrete work was subject to increases in prices of materials and labor, and the comparison of first cost was made on the basis of an old price on steel which has increased.

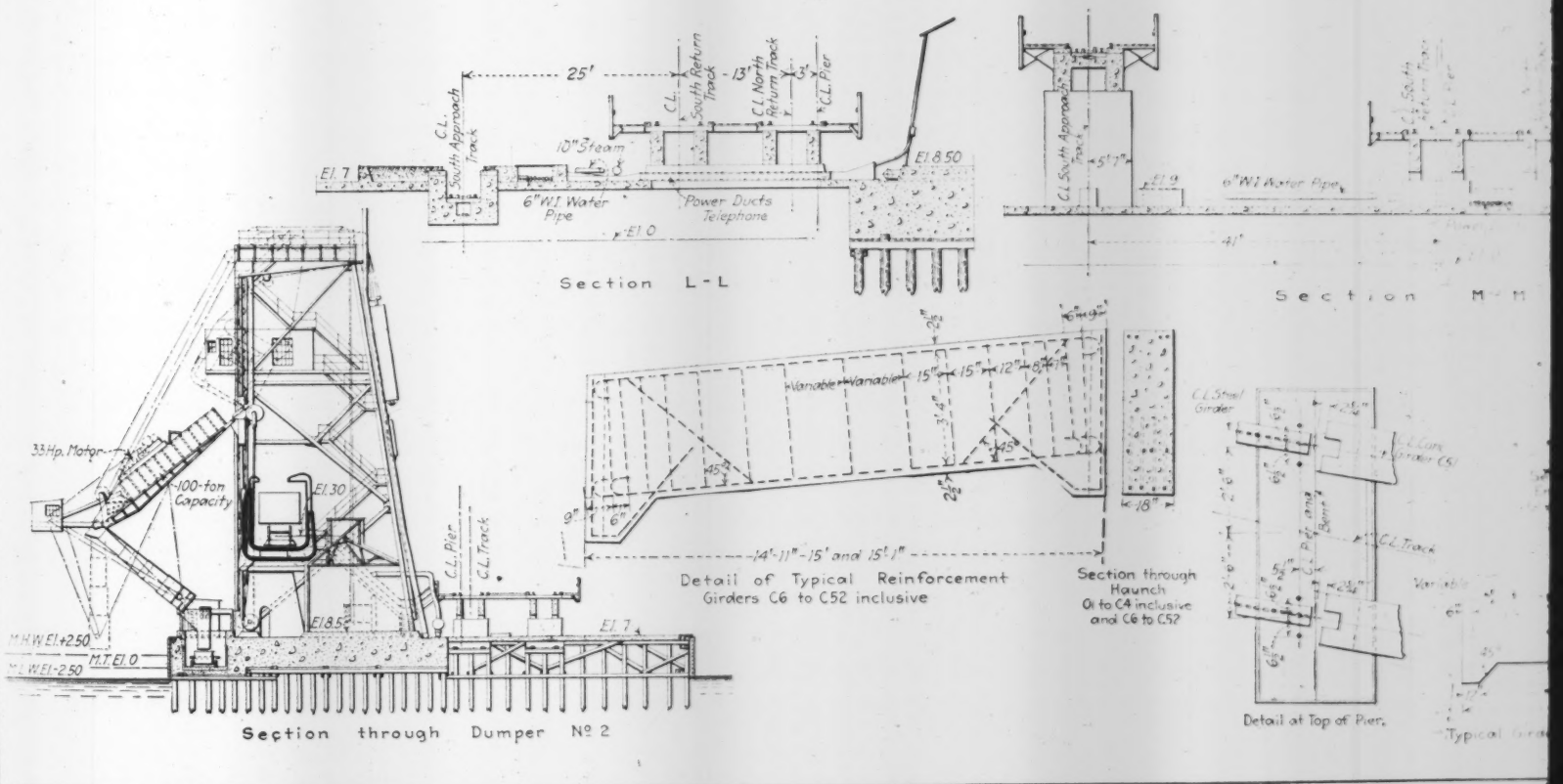
Design of Reinforced Concrete Girders. In the design of concrete girders, details of which are shown in the inset, it was necessary to give special consider-

RUN-OFF AND RETURN TRACKS OF NO. 2 DUMPER LOOKING INLAND FROM KICK-BACK TRESTLE


Haulage Car
-1%
+12%
925'
-0.215%
Longitudinal Section through North Approach, Runoff and Kickback Tracks
Longitudinal Section through North & South Return Tracks, Conveyor "C" and Center Line of Pier

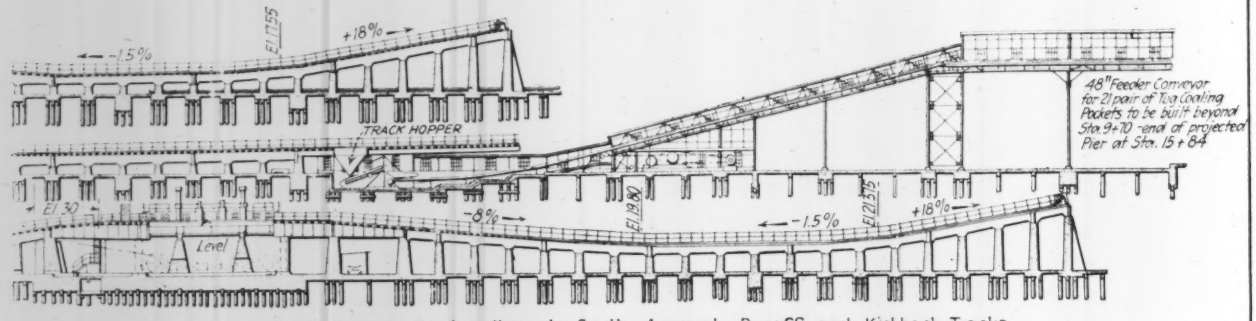


Plan of Pier showing Track Alignment and Location of Dumpe

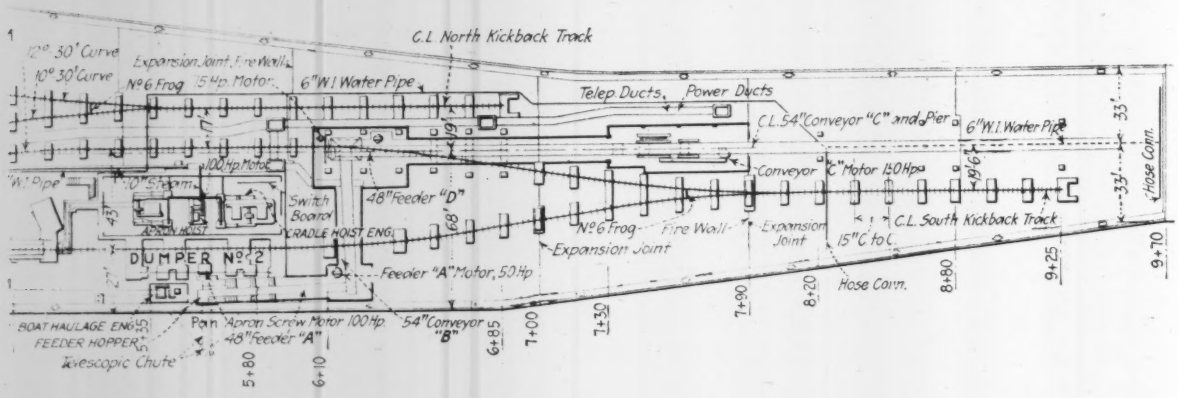

Section L-L
Section M-M
Section through Dumper No 2
Detail of Typical Reinforcement Girders C6 to C52 inclusive
Section through Haunch C1 to C4 inclusive and C6 to C52
Detail at Top of Pier.
33 Hp. Motor
100-ton Capacity
M.H.W. El +2.50
M.L.W. El -2.50
M.T. El. 0

COAL PIER OF CENTRAL RAILROAD OF NEW JERSEY HAS TWO INDEPENDENT CAR DUMPERS—DESIGNED TO HANDLE 400 CARS PER

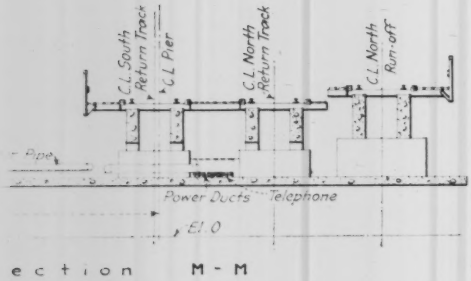
Accompanying article on Design and Operation of Coal Pier, Central Railroad of New Jersey, Jersey, City, N. J., *Engineering News-Record*, April 15, 1920.



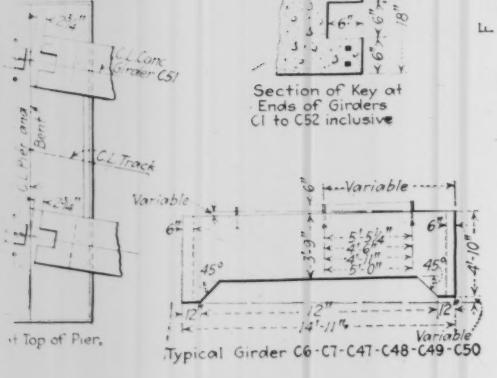
Longitudinal Section through South Approach, Runoff and Kickback Tracks



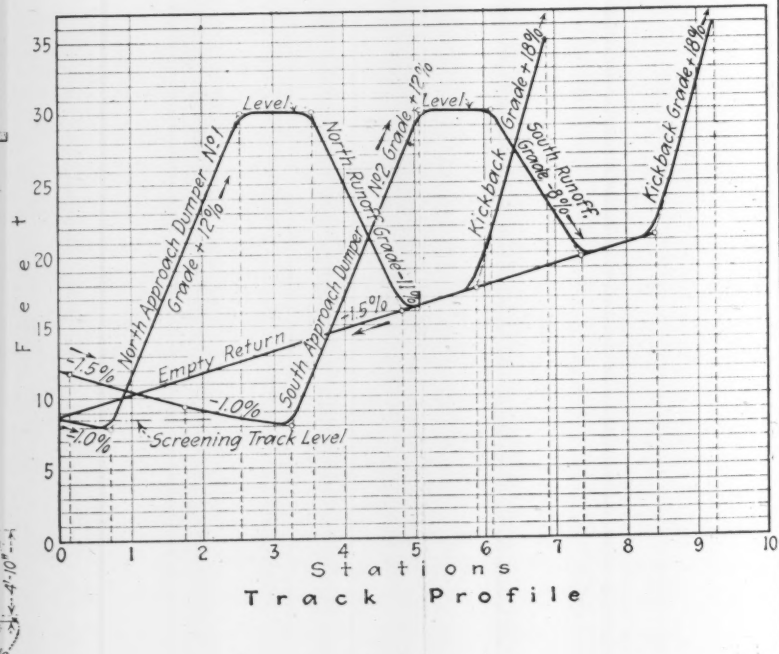
d Location of Dumpers



ection M-M



t Top of Pier.



ation to the fact that the short spans, subject to rolling loads, had high flexural stresses at points of high shearing stresses. This condition was the determining factor in the design of reinforcement. The amount of steel required at the points where rods were bent up to take their proportionate share of shearing stress governed the number of rods required in the bottom of the girders. The track layout determined upon embodied such a wide variation of alignment and grades that the detailing of the girders involved many features not ordinarily found in the design of pre-cast members. It was necessary to provide for numerous variations and at the same time secure a simple and workable unit. A principal consideration was to obtain unit members having as many identical and similar factors as possible to simplify form work.

Under these general conditions, the final design of girders embodies the following features: (1) Both ends of all girders truly vertical and of uniform height, except where special conditions of general layout required a modification; (2) bearing area of all girders truly horizontal and of uniform dimensions; (3) central section of all girders of constant width and height, making bottom plane of girder parallel to top except at ends; (4) angle between bottom plane of girder and sloping plane of haunch at ends uniformly maintained at 45°, and (5) sizes and arrangement of reinforcing bars uniform. Variable dimensions are indicated in the inset, the principal one of which is the slope of the beam, or in other words the angle between the plane of the vertical ends and the plane of the top of the girder. This variation was readily taken care of in the formwork at slight expense.

Partial lateral stability of girders was secured by notching all ties over them and securing every third tie by bolts previously cast in the concrete, while intermediate ties were secured from movement parallel to the length of the girder by the usual timber guard dapped over the top of the ties. Lateral rigidity at ends of the girders was obtained by 1¼-in. rods cast in all piers and extending upwards for practically the full height of the girders, so located as to fit in the keyways provided at the ends. When the girders were placed, these openings were filled with concrete after two layers of tar paper were placed on the surfaces, to insure holding them rigid against lateral thrust but allowing vertical movement in case of settlement at any individual pier. Additional provision for lateral stability was obtained by casting concrete diaphragms between girders at points about three spans apart, bonded to the pier and also to the girders by rods previously cast in both members.

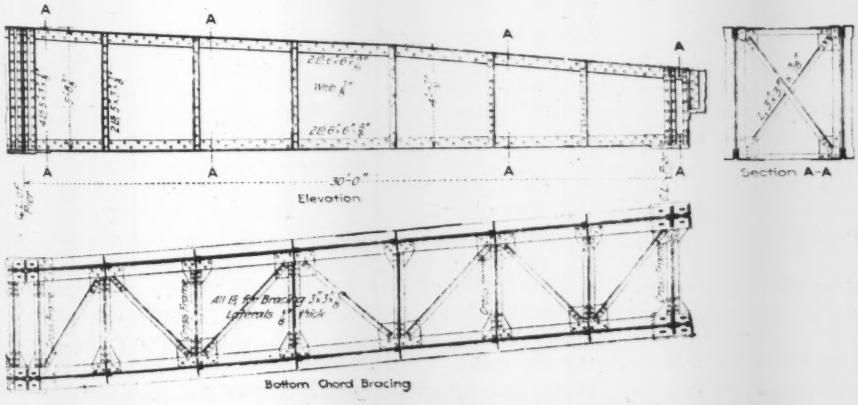
CONCRETE GIRDERS IN PLACE—RUN-OFF TRESTLE

Method of Pre-Casting. All girders were cast flat side down on a wooden platform supported on the concrete track slab at the shore end of the pier. By this method the total height of cast was only 18 in. and stresses in formwork were reduced to a minimum, insuring a plane surface on top of the finished girder, essential for the fit of ties. This system was also found readily adaptable to the numerous variations in slope and other variable dimensions.

After the girders were cured and the forms removed, a 6 x 6-in. timber was secured to the top of the girder by means of bolts previously cast in the concrete for fastening the ties. This timber was provided with an I-bolt at its center for lifting so that the girders could be placed in a vertical position (corresponding to final position in trestles) on the deck by means of a locomotive crane. A yoke made up of a 6 x 8 in. x 3-ft. yellow pine head block with an I-bolt at its center and fitted with two vertical side rods spaced to clear the sides was used for erection purposes, as it was not considered entirely safe to carry the full weight of the girders on the bolts previously cast.

The pier as now constructed (without the off-shore tug coaling pockets) is about 970 ft. long, with a maximum normal width of 136 ft., tapering toward the end to 66 ft. and flaring to 184 ft. at the bulkhead line for convenience of track layout. The pier is built on creosoted pine piles of about 70-ft. length, of which over 4,000 were used. The deck is of reinforced concrete and heavy concrete foundations are provided for the dumpers and dumper-engines.

Operation of the Coaling Station. The two car-dumpers, which operate independently together with gravity yards, are practically identical. Cars are delivered to the dumpers from the gravity yards (including thawing houses, a view of which is shown in the photograph.



DESIGN OF STEEL I-BEAM SPANS ABANDONED FOR REINFORCED CONCRETE

Either of the two gravity yards can be served by either of the classification yard units, but the north gravity yard and the north dumper operate independently of the south gravity yard and the south dumper. To facilitate operation and to make the most economical use of space available, the return yard between the thawing houses is depressed and the lead track connecting with the empty advance yard track passes under the approach of the south gravity yard. The capacity of each of the thawing sheds is 24 cars, or a thawing capacity of about 75 cars per day each. Since many of the grades of coal handled do not require thawing, even in the coldest weather, this total capacity of 150 cars a day has been found adequate.

Operation of Dumpers

After a car is released from either of the gravity yards by its "rider" (who remains with it until it is returned to the empty yard), it is located over the haulage pit and then pulled up the approach grade to the dumper by the haulage car operated by steel cables. When the car reaches the dumper it pushes the car which has just been emptied down the run-off grade. After the car is delivered on the platum of the cradle it is shifted horizontally towards the wooden buffers at the side and then lifted vertically until the clamps, which hold the car in place, are actuated by a contact with them. The car is then raised and the contents dumped into the pan, which has a capacity of 100 tons. It is then brought back to its original position in the cradle; displaced by another car; started down the run-off grade and returned by the kick-back to the empty yard.

To facilitate unloading contents of pan, elaborate provision is made for boat haulage by cables controlled by drums and electric motors. The pan is provided with a telescopic chute that can be set at the desired angle, and is electrically operated. For barge loading the pan may be placed in a lower position, but for very high steamers its position will require that the car be elevated as much as 30 ft. before it is turned over. Provision is also made for raising and lowering the outer end of the pan to clear masts of vessels while being moved and to change its inclination to the minimum degree for handling various grades of coal.

The cradle is 50 ft. long, 15 ft. wide and 15 ft. high, and is designed to handle the various sizes and types of coal cars of widths up to 11 ft. 6 in., heights of 6 ft. 6 in. to 13 ft. and length over couplers of 54 ft. 4½ in. and a maximum weight of 280,000 lb., including weight of coal and tare of car. Counterbalancing of the cradle is accomplished by two concrete weights of 25 tons each and the clamping mechanism is operated through cables by four concrete weights of 10 tons each. Steam power is used to operate the cradle and the haulage car and electric power to operate the pan, chute, screenings conveyor and boat haulage. Dumper No. 2, on the south side of the pier, is equipped with a hopper for handling coal by conveyor to the tug-coaling pockets. Coal may be loaded from the pan either into the boats or discharged into the hopper, from which it is conveyed by means of a series of belt feeders to the main overhead conveyor, which will load the circular concrete bins for tug coaling. In order to provide for a supply to the tug coaling pockets in case of a break-down at dumper No. 2 a hopper is provided in the south return track, feeding directly from cars into the main conveyor. The location of this hopper is shown in the accompanying plan.

The car-dumping equipment, including towers and machinery, was designed and furnished by the McMyler-Interstate Co., Cleveland. The entire plant, including pier, yards and power house, was designed and constructed under the direction of the engineering department of the railroad, of which A. E. Owen is chief engineer, and A. M. Zabriskie, principal assistant engineer.

Worcester Water-Works Reservoirs Drawn Down Against Spring Floods

By George W. Batchelder
Water Commissioner, Worcester, Mass.

As a safeguard against spring floods in the Blackstone River the water-works reservoirs of Worcester, Mass., were systematically drawn down during the past winter. An outline of the governing conditions and of the method used follows.

The storm water and sewage of the City of Worcester drain into the Blackstone River, which is ordinarily a small stream that makes its way through a valley of that name and discharges into Narragansett Bay. Along the banks of this stream, beginning within Worcester, are located many mills which use the waters in part, at least, for power. It was said in 1895 when this city took Kettle Brook, that the Blackstone River power was more highly developed than any stream in the world.

Very unusual conditions existed here in the winter of 1919-20. The city reservoirs were practically filled and the ground saturated with water at the time freezing began in the late fall of 1919. The reservoirs remained full during the winter and meanwhile there piled up on the water sheds between 4 and 5 ft. of snow, forming in all a precipitation of over eight inches.

Melting of Snow Anticipated

During the latter part of February, and with the reservoirs still full with one exception, a study of the situation developed the belief that it was good business to anticipate the melting of the snow by reducing the stored water in the reservoirs, especially as they were bound to fill later, and by so doing, temporarily, at least, hold back the run-off from our sheds until the snows lower down had melted and run away. Consequently, on Feb. 18, orders were given to open the waste gate on the Tatnuck Brook system and waste water until the storage was reduced about 300,000,000 gal. or 30 per cent of the total storage. Later, orders were given to open the waste gate on the Kettle Brook system.

We believe it sound judgment to thus regulate in a measure the run off from our water sheds, thereby reducing somewhat the later flows of the stream.

I do not know of any previous time when action of this sort was necessary, though, of course, there have been times when our waste gates have been opened to prevent too high water levels in our reservoirs.

I am informed that E. R. B. Allardice, superintendent of the Wachusett reservoir, of the Boston Metropolitan Water-Works, has drawn down that reservoir, not wasting the water exactly, neither using it for ordinary purposes, but rather for generating electric power only.

Experiences and Prospects of Inland Waterway Transportation

Following the publication of the series of articles entitled "What Is the Future of Inland Water Transportation?" by Charles Whiting Baker, in the issues of "Engineering News-Record" for January, a number of comments were received. Those favorable to the views expressed therein were for the most part merely commendatory and short. Those correspondents who differed from Mr. Baker generally expressed their criticisms in some detail. The communications printed below all fall in that class except the one by Maj. Bond, which, though written without knowledge of the other letters, is a fair answer to many of the criticisms in them, particularly those which assume that a low ton-mile cost on the waterway itself means low freight carrying charges.—EDITOR.

In Defense of the Inland Waterway

BY J. A. OCKERSON
Member, Mississippi River Commission, St. Louis, Mo.

HAVING been in close personal touch for many years with matters relating to the engineering side of inland water transportation, both in this country and Europe, the writer finds himself unable to agree in many of the statements and conclusions reached in Mr. Baker's extended article. Answer in detail will not be attempted but a few facts that have come under the writer's personal observation or are of authentic record in official reports, will be presented.

Some years ago the writer devoted considerable time to gathering statistics relating to transportation on the Mississippi, covering the period 1865 to 1900. The tabulated results show that river tonnage at St. Louis reached its maximum in 1880 to 1882, eleven years later than stated in the article quoted. In 1881 the grain traffic by river from St. Louis reached 37.9 per cent of the total St. Louis grain traffic. It further shows that while freight rates were constantly decreasing by both river and rail the former always lead the decline by a wide margin.

Rates on grain from St. Louis to Liverpool via New Orleans and the river and via New York by rail to same destination, covering the period 1883 to 1900, gives an average differential in favor of the river route of 6.85c. per bushel of wheat with a minimum differential of 3.77c. per bushel, although the distance via New Orleans, all water route, is over 1,000 miles longer than via the Atlantic seaboard. In 1880 the export of grain from St. Louis by water was 15,762,664 bushels. Today the rate on grain St. Louis to New Orleans by river is 14c. and by rail 17½c. per hundred pounds.

The records of tonnage transported by the St. Louis and Mississippi Valley Transportation Co. show that for the five years 1893-97 inclusive this company carried an annual average of 6,667,145 bushels of export grain, and a large amount of package freight although in four out of the five years the fleet was idle during the months of October and November on account of low water. The average freight rate on wheat, 1896-1900, St. Louis to New Orleans, including transfer to ship for export, was 4.62c. per bushel, a ton mile rate of 1.3 mills.

Note, too, the types of stern wheel towboats then in use. Steamer "John Gilmore," 1,200 i.hp., 7 barges loaded with grain in bulk and fuel barge, 10,810 tons. "Future City," 1,600 i.hp., 8 barges of grain and fuel barge, 11,240 tons. The "upstream load" of less than half this tonnage was composed of lumber and miscellaneous freight. The average time required for the round trip, St. Louis to New Orleans and return, was 20 days. It should be remembered that all this was done prior to the beginning of Government channel maintenance and when depths of 4 ft. were sometimes encountered even on the river below Cairo.

CONDITIONS BETTER TODAY

It is quite different now; a navigable channel 8 ft. or more in depth at all stages of river except when closed by ice, has been maintained from St. Louis to the sea for more than 15 years. For about 8 months in the year the lower Mississippi has a navigable depth of about 12 ft.

The Anchor Line, handling package freight and passengers, had a line of several side-wheel boats of 1,000 to 1,200 tons' capacity which had a regular schedule of 7 days between St. Louis and New Orleans. Both this company and the St. Louis and Mississippi Valley Transportation Co. were highly prosperous and operated well into the early years of the twentieth century until their equipment was worn out in the service. During the period stated the railroads had reached the stage of maximum efficiency.

The coal tows out of the Ohio and down the Lower Mississippi are famous for their large cargoes. The writer accompanied one tow of the "Joseph Williams" from Cairo down, carrying 52,000 tons of coal or over 1,000 car loads and at least 30 trainloads. This was delivered without accident; in fact losses on such trips are the exception rather than the rule.

The purpose of citing what has been accomplished in river transportation under adverse river conditions is to prove that a very large tonnage can be profitably carried now under the greatly improved river conditions. Mr. Baker seems to question this. He also lays stress on the cost of channel maintenance.

A recent circular of the U. S. Railroad Administration covering statistics of one of the most prosperous railroad systems of the Mississippi Valley for 1919 shows annual cost of "maintenance of way and structures" at $2.577 per mile of road, which is doubtless less than the normal cost since maintenance of way has nearly 50 per cent of the loaded freight car miles. Coal been sadly neglected for the past two years. This is at least four times the annual cost of channel maintenance from St. Louis to New Orleans. In the lower Mississippi from Cairo to the Gulf of Mexico, 1,065 miles, there are about 35 sand bars with a maximum aggregate length of 35 miles which may become obstructions to navigation at low water. Only about one-third of these become obstructions during any one low water season lasting about four months and channels through them are easily opened and maintained. Over a thousand miles of the total distance is a natural channel of ample depth.

Maintenance of equipment of the railroad quoted is

given at $3,215 per mile or road per annum, which far exceeds the cost of maintenance of river equipment for the same tonnage.

Again Mr. Baker alludes to limited upstream traffic as a serious handicap. Quoting from the statistics of the same road, the empty freight car miles are equal to nearly 50 per cent of the loaded freight car miles. Coal roads run practically empty trains one way. So, however desirable it may be to have full loads both ways, the lack thereof does not apply with special significance to waterways.

He refers to delays on waterways as being of very serious moment, when as a matter of fact delays due to channel defects need be little or no greater than washouts and other interruptions on railways. As to relative rate of movement on river or by rail it has been found that the time required to deliver freight from St. Louis by river to ships at the seaboard is not materially greater and sometimes even less than by mixed freight to the ships at the Atlantic seaboard. This of course takes into account the switching at both ends of the line and delays at intermediate points and does not include fast freights. As a recent example, a small towboat with 7 barges carried 20,400 sacks of rice which averaged 220 miles per day.

Mr. Baker says the railroads have been built by private capital while the improvement of inland waterways have been made at the expense of the people. He forgets that 158,293,736 acres of land was granted to aid in the construction of 21,510 miles of railroad, 7,359 acres per mile, much of which mileage lies in the Mississippi Valley (see statement by the General Land Office in "Congressional Record" of Jan. 14, 1920, p. 1635) In addition to that, huge blocks of railway bonds were guaranteed by the Federal Government.

Aside from that consideration, however, there are many things done at the expense of the Federal Government for the general good and it must be so. Lighthouses, fortifications, battleships are built, armies and navies are equipped and maintained, the postal service and other functions of the general government are all for the general good. The Federal Government, that is to say the people, own the inland waterways and if the people see fit to spend their own money for the improvement of their own waterways for the general good, why should they be censured therefor?

Transportation by water on a large scale must have such capital behind it as will fully safeguard the interests of the shippers and inspire the confidence of the public, as Mr. Baker says. Just now there is crying need for such transportation. Railways cannot meet the demands for cars and their managers proclaim that it will require the expenditure of billions of dollars to put their lines in such condition as to satisfactorily handle the traffic of the country which is increasing much faster than railway betterments.

Railways Failed Under Government, Too

Mr. Baker's analysis of what he is pleased to term failures in water transportation if applied to railway traffic for the same period would show general failure there as well, both being under the Federal Railroad Administration where the earnings during the two years and two months' operations are said to be $850,000,000 less than the expenses. In the case of the "Mississippi River Section" where a poor equipment illy adapted to the work, was brought together from various sources and overhauled at great expense in order to begin doing something, no one acquainted with river transportation looked for an immediate profit in its operation. The major portion of the fleet came from the Mississippi River Commission working plant and did not "represent the latest improvements in river navigation," as Mr. Baker says, and besides that it was not well adapted to the service in which it was placed. For instance the "Nokomis" was not "one of the improved towboats" but on the contrary was some 20 years old. Furthermore, it must be recognized that developing new routes of transportation or changing old methods, requires time to educate the public as to the existence of such routes and the means of using them so as to reach and build up the best markets.

Taking these things into account it seems absurd to insist that "if these Government boats are to demonstrate that inland water transportation is a profitable business, they will have to earn *next year* a profit above all operating expenses of at least $1,450,000."

Mr. Baker says that "transport on American railways of heavy traffic shows that for movement of the road alone, on such lines as compete with waterways, is less than two mills per ton-mile. Only under most favorable conditions can freight be moved by river or canal at a lower cost." Specific cases of the movement of grain on the Mississippi month in and month out, have already been cited where including transfer from barge to ship and overhead charges the rate was 1.3 mills per ton-mile. In the case of shipments of coal the rate was about fifty per cent less. Let the railways meet such rate and the public would doubtless rejoice.

Neither does the writer agree "that low-grade bulk freight is the only class of freight on which the waterways can hope to compete with railways." A refrigerator barge line for export meats and dairy products to the southern states with return of tropical fruits could probably be developed into a paying business.

He cites figures to show "the absolute impotence of the waterways to supplement the railways at that crucial time" (1917-18) but he fails to recognize the real cause. First, there was great dearth of river boats, and second, there were no ships in the port of New Orleans to receive even the limited amount of river freight, and in spite of the cry of no cars, freight was transferred from river steamers to cars, there to be hauled across country to some congested Atlantic seaport. The City of New Orleans, with its miles of empty wharves, appealed in vain for ships. No wonder river traffic was light under such conditions.

He ridicules the idea of regarding the transportation by water of sand, gravel and stone, as legitimate tonnage. This is a favorite theme with opponents of waterway development. It is true that the value per ton of these items is small, but without them, concrete, which has come into such general use in construction work, would cease to be. These materials are often transported several hundred miles by water. If handled by rail, with either long or short haul, they immediateely figure in reports of tonnage and traffic and are duly charged for and properly so.

The writer agrees that the question of inland water transportation should be dealt with as a business proposition and where it can carry traffic more economically than by other means it should be fostered and supported.

It has been demonstrated on the Mississippi and its great tributaries that traffic can be handled cheaper by water than by any other means. While recognizing that the great volume of freight must be handled by rail, because it can be reached in no other way, still the waterway is needed and can be made useful in carrying a very large tonnage to the decided advantage of shippers and with profit to the carrier.

It has been aptly said that the Mississippi Valley is the "cream jug of the continent" and its chief "commercial problem" has been and always will be, how best to reach the markets of the world with its surplus products. In this matter its waterways to the seaboard will always be the controlling factor in the cost of transportation. From St. Louis to the Gulf at least, the channel maintenance is ample to meet the demands of a very large volume of traffic; adequate equipment adapted to the work required, both as to efficiency and capacity, must be provided and operated in such way as to convince shippers and the public that it has come to stay. Then full cargoes may be looked for, which will result in profit to the carrier as well as to the public. Inland waterway traffic will again be established as an essential permanent and important element in the general transportation problem of the country which after all is the controlling feature in business.

Some Criticisms From a Steamboat Operator

By R. A. Hiscano
General Manager, Catskill Evening Line, New York City

It seems to the writer who has been in the railroad, steamship and steamboat business for a number of years, that many of the statements in Mr. Baker's articles are misleading and unfair to inland water transportation. A detailed examination of some of these statements may be worth while.

In the Jan. 1 article, on p. 19, the statement is made that traffic on nearly all inland waterways has all but disappeared and that with a few exceptions the competititon of the waterways with the railways is no longer of any consequence and that furthermore Government control has demonstrated the fallacy of waterways keeping to a lower level the rail freight rates. Traffic has not all but disappeared from out inland waterways. It is a fact that such streams as the Hudson River, Long Island Sound, Newark Bay, Delaware River, Ohio River and other large waterways are still handling a considerable tonnage. Again, competition between waterways and railways up to the period of Federal control was keen and there is no reason to doubt but what a certain amount of competition will be resumed, now the roads have passed back to their private owners. Government control has not demonstrated that it is a fallacy to suppose that waterways keep down rail rates. While it is true that increased rates were and are necessary on the part of the railroads, a good deal of these increases have been caused by the surrender on the part of the Government to the demand of the railroad unions.

Lake Conditions Can Be Duplicated

Mr. Baker also states in the Jan. 1 article that the success of water transportation on the Great Lakes cannot be duplicated elsewhere and that the low freight costs on the Great Lakes is due to the vast volume of bulk tonnage which is shipped on the Lakes. Now I believe that within certain limits the cost of carrying freight on the Great Lakes can be maintained on such other streams as the Hudson River, Long Island Sound, Delaware River and Ohio River, and while it is true that the bulk tonnage of the Great Lakes has produced some low operating costs, there are also a number of highly successful and profitable merchandise freight lines now operating on the Lakes, companies whose entire tonnage is practically of a merchandise character.

Again in this first article Mr. Baker states that under normal conditions the railways are able to handle all the business of the country and that during the blockade of 1917-1918, although needed, the waterways remained unused. Now this is not so. Railroads, particularly in the more densely populated sections of the country, east of the Mississippi and north of the Ohio River, cannot handle all of the country's tonnage. One illustration near home may be cited. The bulk of the Hudson River Valley fruit crop is shipped each season via the various boat lines operaing on that river, and last summer when one of the lines was offered an unusual quantity of fruit and was unable to handle it promptly a good many of the growers temporarily diverted their fruit to the rail lines, with the result that it took anywhere from three to six days to get the goods to the New York terminals by rail, although the boat lines make an overnight delivery. Thousands of dollars were lost on the rail movement because of the delay. Even though cars were iced, in many instances the fruit perished and was a total loss. The writer knows that not only is this incident true of the Hudson River territory, but it is also true of the producing section south of Baltimore on the Delaware peninsula, also in other sections of the country.

Waterways Did Relieve Freight Blocking

As to the waterways not having been able to relieve the blockade of 1917-1918, the water lines which were in existence did help to meet this situation and relieved the railroads of thousands of tons of freight which it was impossible for the shippers to forward by rail. Right here in the eastern section of the country shippers hired motor trucks and sent them as far as 50 mi. to the waterway terminals in order to get their goods to destination, and were it not for the assistance of the existing boat lines at that time the confusion and delay and loss would have been much more. As a matter of fact it was the fault of the railroads themselves that the waterlines could not handle more tonnage, inasmuch as there were no through routes or through rates in effect via joint rail and water lines to and from a good many sections and the time was too short to establish these rates and routes, even if the railroads had been killing, and as a consequence many shippers held their goods back rather than pay the excessive freight charges which it would have cost them by reason of the absence of these through rates.

Mr. Baker states on p. 26 of his Jan. 1 article that no boat can afford to carry deckhands so as to unload freight at various stops en route. He must surely be unaware of the fact that practically all freight on the Hudson River and, to a great extent, on the Long Island Sound is handled by the deckhands who are carried on the steamers. It is only when there is an abnormal quantity of freight moving that extra longshoremen have to be added to take care of the loading and unloading.

In the Jan. 8 article, on p. 86, Mr. Baker cites the history of the Inland Navigation Co. as proof of the fact that it is not profitable to operate waterway service on the Mississippi River and part of his proof consists of the statement of the revenues and expenses of this company. It is just such fallacies as this which make Mr. Baker's articles so misleading. Merely because an extravagantly managed line could not make a success of the business is not positive proof that with sound business methods a line could not be operated profitably. A steamboat company whose terminal expenses average $2.45 on a ton on a river run cannot hope to succeed. There are boat lines in the east here whose terminal expenses, by which we mean rent, labor, etc., do not exceed $1.00 per ton. Furthermore, the general administration expenses of the above mentioned company for the brief period of its existence amounted to $116,362. This, of course, is entirely out of proportion to the business and should not exceed 45 cents a ton, excluding interest on the investment and depreciation on the marine equipment. Of course this is for purely freight operations and might be slightly different where passenger traffic is also involved. In fact, without going into all the details of the Inland Navigation Company's operations to point out why they could not hope to succeed, I would say that for a purely freight line the steamer expenses ought not to exceed 40 per cent of the revenue, and terminal expense 27 per cent of the revenue, and the overhead, excluding interest and depreciation, 11 per cent of the revenue.

In the Jan. 15 article, on p. 141, Mr. Baker after pointing out that the improved New York State Barge Canal was expected to handle principally the movement of grain tonnage, states that in 1917 only 18,000 tons of grain were moved, ignoring the record of 1918 which shows that 81,091 tons of grain, flour, barley and oats were carried on the canal and that the slight movement of 1917 was caused more by action of the Grain Corporation in diverting the tonnage to the rail lines than it was because of any fault of the canal. It is also interesting to note that in 1919 144,971 tons of coal were carried on the canal and that were it not for railroad opposition this movement of coal could probably be increased ten times, thereby reducing the cost of coal tremendously for the people of New York State. The Superintendent of Public Works, who has charge of the operation of the Barge Canal, has pointed out very ably that the coal fields of Pennsylvania are within a short rail haul of the Barge Canal, and that if proportional rates were established to the banks of the canal the freight rate via rail and water would be considerably lower than the all-rail rate, and that, furthermore, a good many thousand less freight cars would be needed each year to move the tonnage, thereby releasing these cars for use in other sections of the country.

There is one more word about the movement of coal. Mr. Baker, in touching on the Ohio River situation, discounts the use of this stream and does not believe it holds much hope in the future. I would like to refer him to the report of the United States Army Engineers, p. 1378, year 1919, in which it is stated that in the season 1917-1918, 558,000 tons of coal were shipped by water, from Kanawha River fields to Cincinnati, thereby relieving great suffering and avoiding economical loss and that had it not been for the Ohio River being navigable and boats available this coal could not have been shipped as the rail lines were badly congested.

In the Jan. 22 issue, on p. 188, Mr. Baker goes into the question of handling freight by rail and after using a set of average figures inquires whether any water line can afford to operate at as low a cost as 1.60 to 2 mills per ton per mile. Now, I submit that this is not a fair comparison for the reason that there is involved movements of tonnage which are not near navigable streams and have no bearing on this subject. I think a more correct way of getting at the comparison would be to get the average rates per ton per mile from the ports of competing water lines to the destination ports and then see how the figures compare and if this is done I am quite sure that it will be found that the water line operating costs are lower than the rail costs for this service.

Haulage Costs Not High on Mississippi

BY C. McD. TOWNSEND

Colonel, Corps of Engineers, U. S. A., retired; Formerly President Mississippi River Commission, St. Louis, Mo.

The writer has been greatly surprised at the conclusions Mr. Baker has derived from his premises. The gist of the earlier articles is a statement of the utter failure as commercial enterprises of recent attempts to navigate the lower Mississippi and Missouri rivers, of those to tow iron and coal on the upper Mississippi River, and of those of the Railroad Administration to establish a paying line between St. Louis and New Orleans. An effort was made to demonstrate the impracticability of river navigation competing with railroads, yet in the issue of Jan. 29, 1920, it is stated that, notwithstanding the disheartening experience of the Inland Navigation Co. and of the practical disappearance of the river as a competitive factor in transportation, there is a chance that the Mississippi may again become an important waterway, and perhaps the Ohio also.

To justify any expenditure for the improvement of the navigability of our Western rivers it is necessary to supplement such damning praise with a clear demonstation that "if this task is undertaken with a clear knowledge of commercial requirements" there is a reasonable probability of success; i.e., it is necessary to analyze the various failures in transportation on our western rivers, to determine the causes of these failures, and to ascertain how, by proper management, these causes may be eliminated.

The writer, during the past thirty years, has discussed many of the points raised by Mr. Baker before various river conventions and committees of Congress and in a paper on "The Utilization of the Navigation of Large but Shallow Rivers," presented to the XII International Congress of Navigation, held in Philadelphia in 1912, he analyzed the performances of railroads and waterways in carrying freight, and suggested certain indices for determining the relative efficiency of various means of transportation. As a measure of the efficiency of the propelling machinery he used the pounds of coal expended in transporting one ton of freight one mile. For determining the general efficiency of the system he selected the number of men employed per 100,000 ton-miles of freight moved.

COST OF CARRYING FREIGHT

He was furnished data for the preparation of this paper by the Chief Engineers of the Michigan Central R.R., Lake Shore & Michigan Southern Ry., Pennsylvania Lines west of Pittsburgh, the President of the

Lake Carriers Association, and the managers of many of the steamboat lines on the Mississippi, Ohio, and Monongahela rivers.

From the paper is abstracted the following data:

Railroad or Boat	Termini	Distance Miles	Freight Transported Tons	Pounds of Fuel per Ton Mile	Days Labor per 100,000 Ton Miles
Michigan Central..	Windsor to St. Thomas	107	3,300	0.066	1.5
Pennsylvania lines.	Pittsburgh to Ashtabula	125	2,160	0.124	2.5
"G. W. Perkins"....	Duluth to Conneaut	889	10,518	0.029	0.926
"Sprague".....	Louisville to New Orleans	1,330	48,000	0.021	1.31
"Titan".....	Monongahela River	54	3,500	0.217	5.2
Mississippi Packet.	Mississippi River	510	440	1.129	65.64

This table is worthy of careful consideration. The track of the Michigan Central R.R. from Windsor to St. Thomas was selected on account of its being exceptionally free from grades and curves, and the performance of the "Geo. W. Perkins" demonstrates that a railway under ideal conditions can not compete with the existing freighters on the Great Lakes. The Mississippi River packet, however, makes a deplorable showing in comparison, but it should be borne in mind that few, if any, railroads in the United States have the ideal conditions selected as a standard, nor can 3,300 tons be hauled by a single locomotive on the ordinary track. (The average load of all freight trains in the United States in 1909 was 356 tons.) Nor does the average freight train travel long distances at the rate of 100 miles per crew day.

If it be assumed that a train crew of five men is employed in transporting 356 tons 50 miles, the index of efficiency is changed from 1.5 per 100,000 ton-miles to 28, and it is probable that a poorly managed railroad in a country with low density of traffic would not make a much better showing than the river packet.

Towboat Investigation

By authority of Congress, a Board on Experimental Towboats was appointed by the Chief of Engineers, U. S. A., which submitted a report on the proper type of boats and barges to be used for towing on non-tidal rivers, and a reorganized board has been appointed which at the outbreak of the war was engaged in determining, by suitable experiments, with different types of boats, the practical applicability of the conclusions of the original board. For this purpose the board selected the steamer "Nokomis," not, as stated by Mr. Baker, because it represented the latest improvement in river navigation, but on the contrary because, though of the general dimensions of the boat recommended by the original board, it was over twenty years old and had many of the defects that it was desired to correct.

The scheme of the board was first to determine the performances of the old type of Mississippi River towboat, when running without cargo, and then with tows of six, four, and two loaded barges, and afterward to determine what economies could be successively obtained by changing the diameter of her wheel, substituting a feathering wheel for the old type of radial wheel, substituting compound condensing engines for the old high pressure type, and replacing the old Mississippi boilers by those advertised as having greater efficiency.

These experiments were to have been supplemented by others on the "Wm. R. King" and the "Inspector." The experiments were being vigorously prosecuted when the war occurred. The Senior Member and the Recorder of the board were ordered to France; the work was suspended; and the boats transferred to the various agencies which have since been operating them with the result that even the partial data that the board collected has not been utilized.

A comparison of the performance of the "Nokomis," while being employed experimentally by the Towboat Board, with the results, while she was regularly running in the service of the Railroad Administration, is quite illuminating. Under the Towboat Board, with a fixed radial wheel, she towed six barges with a load of 3,189 tons from St. Louis to Cairo and returned with a cargo of 3,039 tons, with the following results:

	Distance, Miles	Freight, Tons	Pounds of Coal per Ton-Mile	Days Labor per 100,000 Ton-Miles
Downstream	173	3,189	0.150	3.32 —9.29
Upstream	167	3,039	0.739	15.96

When towing downstream the results are comparable with those of the Pennsylvania R.R., given in the first table, but the tests upstream show that the boat, with her old high-pressure engines, has not sufficient power to economically tow such a load. During the six months, January to July, 1919, while the boat was under the Railroad Administration, the "Nokomis" has a record of 13,254,301 ton-miles, with an average consumption of 0.531 lb. of oil per ton-mile, and a labor charge of 32.46 per 100,000 ton-miles. Assuming that 1 lb. of oil is equivalent to 1.7 lb. of Mississippi River coal, the coal consumption per ton-mile is 0.902 lb. The tests made by the Towboat Board were straight runs, while the records of the Railroad Administration include not only the time in transit but the delays incident to repairs to machinery, time lost by fog and grounding, and time spent in port waiting for the formation of a tow, etc. The following shows the general percentage of operating efficiency during the six months:

	Per Cent
Bunkering oil	1.4
Way Landing	1.6
Machinery delay	7.9
Channel delay	0.2
Fogs and night	4.3
Terminal delay	28.4
Running time	56.2
	100.0

Reasons For Delay

A delay of only 0.2 per cent from grounding is indicative of a channel of ample depth, a delay of but 4.3 per cent during nights and fogs demonstrates that the channel has been efficiently bouyed and lighted. While a loss of 7.9 per cent of the time in repairs to machinery merits careful investigation, the item which is financially disastrous to the enterprise is the loss of 28.4 per cent at St. Louis and New Orleans waiting for freight. On the Great Lakes, during the past eight years, the average time spent in port during the season of navigation at both the Lake Superior and Lake Erie harbors during a round trip has been about 30 hours. With the Railroad Administration the time lost at St. Louis and New Orleans per round trip is about eleven days, or one-half the running time. The cause is not difficult to determine. There have been in operation five or six towboats and 29 barges. The experiments of the Towboat Board indicate that with a tow of six barges, averaging about 3,000 tons downstream and returning half loaded, the "Nokomis," even with

high-pressure engines, can be operated economically; but this necessitates that on her arrival at port there will be six loaded barges ready for the return trip. With five towboats it was impossible to make such a combination; there were not enough barges for the purpose; and it was necessary to wait in port until the barges could be loaded by antiquated methods.

Another disastrous consequence also resulted from this storage of barges. It was noted that the pay of the crew while the boat remained in port was largely increasing the cost of operation, so the boats were started on their trips without waiting for an economic cargo. The figures stated above would indicate that the average tow of the "Nokomis" was less than 1,000 tons. The experiments of the Towboat Board showed that a reduction of freight towed from 3,000 to 2,000 tons doubled the number of days labor per 100,000 ton-miles. Economical towing has been sacrificed for promptness of delivery.

A similar analysis of the efficiency of the "Scott" when operating in the Missouri River in 1914 shows the following:

	Per Cent
Bunkering oil	1.8
Way landings	
Machinery delay	6.3
Channel delay	10.2
Darkness and fog	37.9
Terminal delays	17.3
Running time	26.4
	99.9

As a large percentage of machinery delays were due to damage to propeller and rudder from grounding, the failure on this river may justly be ascribed to the shallowness of the channel.

The abortive attempt to navigate a 4½-ft. channel in the Upper Mississippi River with cargoes of iron ore drawing over 5 ft., should not be ascribed to a faulty river channel but to the personal equation of the individual who conceived such an idea. Since the signing of the armistice, iron ore has been shipped from St. Paul to St. Louis over the same channel; but in boats drawing 3½ ft. A considerable amount of printers ink has been expended on both experiments, but a demonstration that the depth of channel limits the draft of boats adds little to the advancement of scientific knowledge.

The Towboat Board has, however, ascertained that in deep channels the old type of barge offered a resistance of 2.8 lb. per ton of displacement when towed at a speed of 5 mi. per hour, as in the first experiment, while the new barges employed in the second experiment under similar conditions, had a resistance of but 1.7 lb., a fact which if corroborated by experiments with a draft of 6 ft., will lead to a revolution in barge construction on the Mississippi River.

Nor should too much weight be given to the fact that the "Nokomis" and a number of barges were transferred from the Experimental Towboat Board to a contractor inexperienced in river navigation who permitted the War Department to overload the barges and then attempted to navigate the Mississippi River at a time when ice is ordinarily encountered. The expected happened, and an ice floe overturned two that were exceptionally topheavy. The fiasco should be attributed not to the river channel but to the condition of the public mind at the outbreak of the war.

The navigation of the Mississippi was undertaken not as an economic proposition but as a means of supplementing the railroads in getting supplies to France without anyone stopping to consider that there were neither boats nor barges suitable for the purpose. An enthusiastic desire to do things without any considerations of cost swept over the country.

The overhead charge of $272,000 for salaries, quoted from Director Tomlinson, can be ascribed to a desire on the part of the Railroad Administration to demonstrate to the people and Congress that things were being done on a large scale, untrammeled by petty financial considerations.

The writer is not prepared to criticize the Railroad Administration for assuming such a position. In establishing a new industry, judicious advertisement is sound policy, and during the war economical methods were ignored in all Governmental transactions. But our war intoxication is subsiding, and the morning after has arrived with a debt of over twenty-one billions of dollars and annual taxes of six billions. There is danger unless we quickly return to the fundamental principles of economic administration, that the future of inland water transportation will be wrecked.

Why So Many Water Transportation Projects Fail

By P. S. Bond,
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Charles Whiting Baker's articles on inland water transport in the United States are of particular interest and value, just at this time, because he looks at the problem from its most important, but hitherto most neglected side—that of economics. He is absolutely correct in his statement that the lack of intelligent planning is the cause of the waste. If those responsible for waterway construction had to earn dividends on their projects, show returns or else stand discredited, there would be a mighty reduction in the waste.

The actual construction work has been well done—too well done in many instances, for the better the work the greater the waste, if the project is economically unsound. What is lacking to success, as Mr. Baker says, is someone with intelligence enough and authority enough to determine which works are worthy and which are not.

The Corps of Engineers of the Army, by virtue of its long experience in waterway construction, has the intelligence, but it certainly has not the authority. Congress has the authority, but it certainly has not the necessary knowledge, based on study and experience. And there is the rub. We cannot create in this country any power superior to Congress, which is the supreme authority in the prosecution of the public works. Congress has never seen fit to delegate its powers in this matter to the Corps of Engineers, nor could it legally delegate such powers to the Corps, or to any other body which Congress itself might create. Congress itself can never acquire the necessary expert knowledge on all subjects, though individuals frequently do become experts along certain lines—as did Theodore E. Burton, for many years chairman of the House Committee on Rivers and Harbors.

The Corps of Engineers is limited by law to reporting only upon the individual and usually unrelated projects which Congress names. It has never been directed or permitted to prepare and make public a broad, comprehensive scheme of inland waterway im-

provement. Nevertheless such a scheme is the very first step necessary to promote efficiency and eliminate waste. It is very difficult, in fact impossible, to determine whether a certain waterway is worthy of improvement when its relation to other waterways is not definitely determined, when it is not known what the scheme as a whole includes, nor what other waterways will be built. Under such conditions it was to be expected that mistakes, sometimes very expensive mistakes, would be made.

Congress is not bound to follow any such comprehensive scheme, whether evolved by the Corps of Engineers or any other body, whose recommendations would accordingly be purely advisory. Nevertheless, they would furnish Congress with a guide which it has hitherto lacked, and if given wide publicity would cause public opinion to be exerted to influence appropriations of money.

The Chief of Engineers makes public each year figures whose study would clearly show just which projects are earning fair returns on their investments and which are not. But the public cannot readily interpret these figures, which are not presented primarily as economic studies. The public does not realize that they are stockholders in this waterway enterprise, because the profit or loss does not directly affect them as the profit or loss of a corporation affects its stockholders. The average small stockholder takes little interest in the annual statement of his company, but he is instantly alive if a dividend is omitted or an extra dividend declared. This important feature is lacking in governmental projects, and there is the chief difficulty, which cannot be entirely removed.

The success or failure of a private enterprise is determined and known to all solely by the dividends it pays or fails to pay to its stockholders. If it fails to pay, the stockholders demand a new management and new policy. It is very difficult to provide any kind of a substitute for all this in government procedure. Nevertheless we must do the best we can under admittedly difficult conditions.

How Waterways Should Be Managed

The first step, undoubtedly, is for Congress to call for a comprehensive scheme to be prepared and kept up to date by a permanent advisory board, commission, bureau or department. And Congress should then refuse to appropriate funds for any project not recommended by this body. Based on the amount of money Congress deems it wise to expend for the purpose, this advisory body should prepare a program for the most effective expenditure of available funds. Whether this advisory control be exercised by the Corps of Engineers or by a new Department of Public Works, in either case the results would be better. The Corps of Engineers, whose officers hold permanent commissions, are less subject to political influences than any body of civilians. Having nothing to gain and nothing to lose by their support or opposition to any project, their recommendations should, generally speaking, be free from personal or political motives to a greater extent than could be expected if they held office by virtue of political appointment.

The writer has been connected with many waterway projects, and very early came to the conclusion that the economic problems involved were usually more important and more difficult than the engineering problems. He thoroughly believes that these economic problems should receive more consideration than they usually have received. The following are a few of the general economic considerations that are applicable to all projects for inland waterways:

Considerations That Should Govern

1. That the fact that a ton of goods may be moved one mile by water (considering cost of movement only) more cheaply than by rail, which is the favorite argument of the waterway enthusiasts, does not mean that water transportation is always, or even usually cheaper than rail transport. There are many other elements which enter the problem.

2. That in the field of inland transportation, unlike ocean transportation, the waterways and railways are in competition. That railroad transport is the most generally applicable. That an inland waterway to be an economic success must enjoy certain favorable natural conditions, which are few in number and comparatively easy to perceive, although generally overlooked, either through ignorance or intent. That if all these conditions exist in any case (as on the Great Lakes, the waterway is practically certain to be a success; that if one or more of them exist it *may* be a success, but should be carefully investigated; and that if *none* of them exist, as is the case in perhaps the majority of our inland waterway projects, it is a foregone conclusion that the waterway will be an economic failure.

3. That many of the most important items in the economic prospects of proposed waterways have generally been overlooked by their advocates. Chief amongst these oversights have been the following:

(a) Failure to include the cost of the government subsidy as a part of the true cost of transportation. This subsidy includes not only interest on the first cost, but operating expenses, repairs, new capital, and a number of lesser charges.

(b) Failure to accurately predict the traffic possibilities, the rate at which traffic will be built up, and the effects of these on the government subsidy. If the actual traffic should be, for example, only one-tenth that which has been predicted, the government subsidy per ton-mile may be nearly or quite ten times as great as if the predicted traffic had been realized. This is the most important consideration in connection with waterway projects, while at the same time the one which has received the least attention and study. As a consequence the predicted traffic has often failed to materialize and a project which looked promising on paper has proved actually an expensive failure.

(c) Failure to accurately estimate the true cost of carriage on the waterway, as affecting the rates that commercial carriers would charge, and their influence on the growth of traffic. This is closely related to (b) and has been similarly neglected. There is a vast number of items which enter into this cost of carriage, which have frequently been guessed at or entirely overlooked, in the most cavalier fashion by some of our too ardent waterway enthusiasts. It is necessary to follow an assumed shipment through its origin to its destination, carefully estimating all the charges that may be laid against it, such as collection and distribution by rail, terminal and transshipment charges,

the influence of vessel types, insurance, delays of all kinds, etc.

(d) Failure to make allowance for the great difference that always exists between the *average* and the *maximum* in all human performances. Because a certain lock has been able to pass a vessel in 15 minutes, it has been estimated that there would be at that lock 4 lockages per hour, for 24 hours and 365 days each year, and traffic predictions actually based on this assumption. Because a vessel will carry 3,000 tons when fully loaded, it is assumed that it will transport 6,000 tons on every round trip. Because a vessel can make 6 miles an hour in a canal, the time of passage is determined by dividing the length of the canal by six. If a vessel has once made a round trip in a week it is assumed that *every* vessel will make 52 round trips, fully loaded in both directions, year in and year out. Such assumptions naturally lead to expensive mistakes. No system of transportation operates like a belt conveyor, yet it has often been assumed that it would.

4. Failure to study the performances of existing waterways, their traffic conditions and the reasons for their success or failure. If the New York State Barge Canal is an economic failure, and there is every indication that it is and will continue to be, that should be a powerful deterrent on the construction of *similar* waterways in other localities, where the prospects are even less promising than they were in New York.

Channel Improvement for Upper Passaic River

A new proposal for reduction of flood losses in the Passaic River valley has been made by Henry B. Kummel, state geologist of New Jersey, in a report to the state's Department of Conservation and Development, just published. Unusual topographical conditions control the problem. The Great Falls at Paterson and a smaller break in profile at Little Falls, at both of which there are now power dams, regulate the discharge to the lower river. The 773 sq.mi. of drainage area above Little Falls include a large extent of marshy bottom lands, of which over 13,000 acres are flooded annually, while in the greatest flood on record (October, 1903) 22,323 acres were flooded. Because of the great storage effect of this marsh area and its value for the protection of the river valley below Paterson the elimination of floods in the marshes is undesirable. Following the 1903 flood a project for permanently ponding the water over the marsh area by a dam at Little Falls was worked out, but this as well as a modified project for ponding only the tributary Pompton River by means of a dam at Mountain View failed to receive approval. Mr. Kummel now proposes channel enlargement from Little Falls upstream to Two Bridges for a capacity of 8,000 cu.ft. per sec., and a somewhat lesser enlargement from Two Bridges upstream to the mouth of the Rockaway River, distances of three miles and ten miles respectively. This improvement, he concludes, would not increase floods from the lower river but would reduce the overflow period of the marshes from an average of twenty-nine to about four days per year. In addition to improving the agricultural condition of the Upper Passaic basin, this would reduce the mosquito crop of the marshes very greatly, he believes. The cost of the project would not be over one-twentieth that of the reservoir.

Composite Distribution System for Small Water-Works

DISTRIBUTION SYSTEMS consisting of cast-iron water mains so located as to supply fire hydrants and of small cement-lined, wrought-iron pipe to serve for domestic supply on minor streets were suggested by E. D. Eldredge, superintendent Onset Water Co., Onset, Mass., in a brief paper read before the New England Water Works Association Feb. 11. The author had in mind places with "a small and variable population in a relatively large area of irregular layout of streets" like the "average summer resort or oldtime village," more particularly in New England.

Mr. Eldredge suggested that the first thing to do in designing such a distribution system would be to locate the fire hydrants. These should be on mains never less than 6 in. in diameter. For street mains on which no hydrants were to be located branches of "wrought-iron threaded pipe, 2-in., 1½-in., or 1¼-in., cement lined, will not only do the work but will do it decidedly better than a larger cast-iron main," Mr. Eldredge stated, "as it is not subject to internal corrosion or tuberculation, and does not produce red water. The author based the foregoing statement on twenty years of personal experience.

What the author described as "the favorite method" of making connections between the cast-iron and the cement-lined pipe is a "tapped tee in the main or a tapped plug in a cast-iron tee or cross. If the branch is to be connected to a main not provided with such a tee, two or more ordinary corporations may be put in, connected by means of a manifold, having all the iron parts cement lined. Iron body gate valves are used, also cement lined, except, of course, the brass working parts."

He also suggested that the best practice would be to have the cement lining of the smaller pipe done by the water-works force, employing for that purpose the same men as lay the pipe. This would afford winter work for the water-works employees.

Would Line Service Pipes Also

House service pipes connected with the cast-iron fire main would in all cases be cement lined also. "For ordinary house services ¾-in. pipe is sufficient," Mr. Eldredge says, "the pressure being about 45 lb. Where the soil is good, particularly if it is sandy, a rigid connection between this sort of service and the cast-iron main is satisfactory." Mr. Eldredge adds: "Not one such connection has failed out of nearly nine hundred. The corporations are tapped level in the side of the main."

In providing for prospective service connections to cement-lined street mains Mr. Eldredge states: "Tees with ¾- or 1-in. plugged branches were introduced at desired intervals as the pipe was laid. The tees were cemented integral with a nipple about 4 in. long. This nipple with the tee combined was screwed into the coupling on the main, thus avoiding the removal of a coupling, and an imperfect joint."

For convenience in handling and inspection it is suggested that a standard length of 2-in. wrought-iron pipe be cut in half before being lined. The shorter length gives better chances for location of tees. Pieces of pipe 4 or 5 ft. in length are kept in stock, "all the couplings well screwed on before lining."

Some Forces in Engineering Education

By Homer A. Watt, Ph.D.
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THE various forces operating to direct the current of engineering education may be classified roughly into two divisions, the internal and the external. The first is mainly academic; it is the force created by the pedagogical creeds and special interests of teachers, and its operation tends to result either in a curriculum that represents the co-operative and collective judgment of the different departments of the technical school or in one that shows clearly their relative strength and diplomatic skill. It is not to be supposed that this force ever operates alone or uninfluenced by other forces; nevertheless, it is powerful in its effects for the reason that the men who create it are the ones who determine the content and emphasis of the curriculum. It is important, therefore, to note the center of their interests as contrasted with that of the representatives of the external forces of which I shall speak later. The central interest of most university teachers is in the subjects taught and the methods of instruction, and in the students as students rather than as prospective professional men. Few teachers take into account the service to the community which their engineering students will be expected to render five or ten years after graduation.

> The central interest of most teachers is in the students, as students, rather than as prospective professional men.
>
> The demands of the manufacturing industries tend toward a quantity production of craftsmen by technical schools, while engineers call for quality production of professional men.
>
> The engineer cannot play his part by the side of educated professional men without a broader training in history, English and the social sciences.

Are Industry's Needs Ignored?

The external forces created by the demands of manufacturing industries and the engineering profession have been exhaustively studied by Dr. Mann in the early chapters of his recent report on engineering education. (See *Engineering News-Record*, Oct. 24, 1918, p. 742.) Their strength lies in the fact that their representatives absorb the product of the technical schools. The schools are the factories; the students are the raw material; the industries and the profession are the market—they test the goods that the schools produce and accept or reject them. No technical school that makes any claim to serve the community by training young men can afford, therefore, to ignore the market. Few do so entirely, but it is possible for a school to become so afflicted with ingrowing self-interest that it tends to create a curriculum which does not take sufficiently into account the end for which the institution exists.

Upon such a tendency there is at present no adequate check, for the weakness of the external forces lies in the circumstance that they *are* external; their representatives have no direct voice in determining the content or emphases of the curriculum. It is true that they have some indirect influence, but it is indirect. While the gifts of equipment from manufacturing industries to technical departments of the engineering school may advertise the givers and pave a path from school to factory, they do not entitle the donors to a vote at faculty meetings. Also the engineering profession, keen as is its interest in problems of engineering education, must still rely upon the indirect methods of addresses and special articles, and Mann reports to make its voice heard in the councils.

Perhaps it is not to be expected that this situation can be made radically different, for, after all, problems of instruction are mainly for teachers to solve. I believe, however, that a clearer understanding on the part of teachers of engineering students of what the industries and the profession want is highly desirable, if for no other reason than that the center of interest of the representatives of these outside forces is quite different from that of most of the teachers. The teachers, it has been said, are concerned primarily with the raw material and the process of manufacture, and the outsiders with the finished product. When the teacher has the outside as well as the inside point of view, who can deny that his judgment in planning and teaching will be sounder, broader and better balanced?

Quality vs. Quantity in Schools' Products

Even when teachers become willing to broaden their vision by studying the outside demands they will not find that all difficulties have vanished. They will find, I believe, that the industries and the profession, alike in their interest in the finished product rather than in the raw material and the process of manufacture, are by no means alike in their definition of what the finished product should be. Indeed, the two demands are to a large extent opposite. The demands of the manufacturing industries tend, I believe, to influence the technical schools to a quantity production of craftsmen; the demands of the profession tend, on the contrary, to create a quality production of professional men. I will try to trace these tendencies to their sources, and show also why I think that the second is likely to prevail in its influence upon degree-granting technical schools. It should be understood that I am writing only of general tendencies and not of exceptional cases.

The evidence presented in Dr. Mann's report (pp. 19-20) does not indicate that the manufacturing industries have an overwhelming preference for engineering-school graduates over practically trained men. In fact one-third of the manufacturers questioned for that evidence preferred practical men, and one-sixth had no preference. Evidence which I have gathered in interviews with employers seems to indicate that they do not care where their apprentices are trained provided the young men have certain fundamental qualifications. One employer wanted his employees to possess "analytical power"; another insisted on "intel-

ligence, energy, and judgment"; a third thought that candidates should show "capacity and the probability of being of service to us." No one thinks, of course, that these qualities are the exclusive product of the technical schools. The point of view of the average employer is probably well expressed by the phrase of the last one whom I have quoted; "they must be *of service to us.*"

However philanthropic the employer may be, his chief interest is in his business, and he can no more be expected to retain permanently and after fair trial an inefficient employee than he can be to keep in his shops an antequated and wasteful tool. Hence it is that the various apprentice courses through which new employees are put, though modified, no doubt, by a human interest in the boys, are designed primarily to benefit the employer by making the employees more efficient. If new employees could be put immediately into staff positions this situation would not exist, but, as it is, almost all—engineering-school graduates included—begin in the line and work up, and only a very few get to the top. The manufacturers will welcome, therefore, any process that will shorten the necessary training period and insure enough men for the line positions. For this reason—their busness demands that they be concerned more immediately with the many needed in the line than with the few needed ultimately on the staff—I believe that their influence upon technical schools tends to create a quantity production of craftsmen. And I believe, too, that the pressure for a two-year course almost exclusively technical, a course that would tend to make industrial schools of our engineering colleges, will come from the needs of the industries.

Manufacturers must not skim the cream of graduating classes to secure mere craftsmen

Engineers and teachers of engineering must see more of each other.

The engineering college which neglects the cultural elements in its curriculum will find itself, in a few years, only an industrial school.

The Professional Point of View

The concern of the engineer as a professional man with the engineering-school graduate is quite different from that of the manufacturer. It is not a business but a professional concern; the engineer sees the technical-school graduate as a new member of the profession. Dr. Mann has pointed out in his report (pp. 18-19) the growing professional consciousness of engineers and their eager desire to define their profession and mark out high standards for it. Just as reputable physicians resent the claims of quack doctors and reputable lawyers those of shysters, so leading engineers object to sharing their hard-won titles and prerogatives with unprincipled and unqualified claimants.

In the 1910 Census Report 208,996 persons reported their occupation as that of "engineer." "Probably not more than 80,000 of these engineers," said Dr. Mann, "could qualify for membership in any of the professional societies mentioned." Engineers who are college graduates with degrees that represent years of arduous and successful study and training do not want to have their honors cheapened by the false claims of craftsmen who, whatever their skill, have nothing of the constructive imagination and scientific equipment of the qualified professional man. In defining and defending their profession, engineers must resist that human desire to get honors cheaply which leads the barber to daub "tonsorial artist" on his shop window, the janitor to prefer the title of "curator," the *masseur* to claim the dignity of the physician and surgeon, and the student to seek a short and soft road to a degree. Engineers, in other words, are at that point in their definition of their profession where the surgeons were when they petitioned George II for a separation from the barber-surgeons.

One definite step which engineers—real engineers—are certain to take in their growing efforts to defend the respectability and define the standards of their profession is to protect the world from a flood of cheaply trained men claiming qualifications which they do not possess. All engineers are not "licensed" or admitted to the bar" as are doctors and lawyers; other means must be taken to protest the profession. Qualification for membership in the engineering associations is one means of protection; another is protection of the engineering degrees. Any cheapening of the engineering degrees is certain to depreciate the value of all technical degrees current; any stiffening of the requirements for the engineering degrees will, on the other hand, increase the value of those held by men already in the profession.

Every influence of the engineers as professional men is bound, accordingly, to be directed toward broadening the curriculum of the technical schools and making engineering degrees more difficult of attainment. Engineers are professionally jealous; they resent the claims of lawyers and doctors to higher places in the service of the world. It will not be found, therefore, that they will favor in the technical schools a short course on the S. A. T. C. Division B model designed for the quick production of a cheaper brand of engineer, a variety like the barber-surgeons.

This professional jealousy of the engineer and his attitude toward engineering education was brought home very vividly to me at a joint meeting of several of the great engineering societies which I attended in New York City, in March, 1919. Several engineers of national reputation spoke on the general subject of the relation of the engineer to society and government. In all the addresses two propositions kept recurring: (1) The engineer has moved out of the hired-man class and is entitled to rank professionally with doctors and lawyers; but (2) he cannot play his part richly and fully by the side of "educated" professional men, without a broader training in history, English, and the social sciences than the engineering schools have heretofore given him. I have heard engineers express these same ideas repeatedly; thy are reflected in the Mann report, and are the frequent subject of articles in the technical journals. A recent example is the article "Engineering Education and Life" by Cyrus Townsend Brady, Jr., in *Engineering News-Record*, Jan. 1, 1920. p. 31.

It would seem, therefore, that the influence of engineers as a profession upon engineering education is as

likely to be in the direction of creating a quality production of broadly trained engineers as that of the manufacturers is likely to tend toward creating a quantity production of less qualified men. To these hypotheses I should like to add briefly my reasons for thinking that the professional influence will be stronger than the industrial.

In the first place engineers, as a profession, are more concerned with the technical-school training than are the manufacturers who, as has been pointed out, show no decided preference for college graduates as employees. Even though engineers tend to judge the training given by the results as shown in the graduates, the keenness of their general interest in engineering education is shown by the part played by their societies in the preparation of the Mann report. Moreover, this interest is growing, rather than diminishing, and the examination of the qualifications of technical-school graduates will be increasingly sharp. This means that the profession is much more likely to hold the engineering schools to a strict accountability for its products than are the manufacturers.

Finally, if the analogy between doctors, lawyers, and engineers—which engineers are fond of making—is sound, it is reasonable to suppose that the same evolution which has added elements of a cultural education to the professional training of the doctors and lawyers will repeat itself in the education of engineers. This does not mean, necessarily, that the course will be lengthened; the demand of society for engineers may prevent such an immediate development. It does mean, however, that the broadening of the engineering course by the addition of some of the so-called cultural elements is so inevitable that the engineering college that resists the pressure will find itself within a very few years no longer an engineering college but only a high-grade industrial school granting degrees that cannot compete with those given by technical schools that have higher aims.

Combination of the Three Forces

In conclusion, how should the forces of which I have been writing co-operate to produce professional men of the highest type—cultured and technically qualified engineers.

The technical-school teachers cannot, as I have said, be longer indifferent to the product which they are manufacturing. Self-sufficiency and ignorance of outside demands, and a higher concern for their subjects and their methods than for the qualifications of the graduate to take his place in the world are certain to result in misdirection and even paralysis of their efforts. Nor can they afford to disagree among themselves; while the doctors quarrel, the patient gets sicker. The teachers of technical subjects who assume a contemptuous attitude toward so-called cultural subjects have as much to answer for to the engineers who are demanding a broader training, as have the teachers of cultural subjects who adopt a supercilious attitude toward the indispensable basic technical courses. The only sanity and safety lie in mutual willingness to study the goal of all efforts and bury professional jealousies in the general problem of producing that type of engineering graduate which the experience of leaders of the profession shows to be best.

The manufacturers, for their part, should be willing to do what many are already doing—recruit their line men from high schools and industrial schools and from among those students who have failed to secure their engineering degrees because of fundamental deficiencies of intellect and character likely to keep them from becoming leaders of their profession. They should not skim the cream of each graduating class for the purpose of securing mere craftsmen. Where such men are put through apprentice courses, it should be done with the deliberate intention of developing them for the higher uses of their profession and not of training them for immediate service in one company. By such sacrifice of immediate returns the manufacturers will be doing their part toward the creation and maintenance of high professional standards. If, in addition, they insist upon the possession by engineering-school graduates of such fundamental qualities as reliability, integrity, industry, and accuracy, they will exert upon the schools an influence of undeniable value.

The profession has already done much for engineering education and is prepared to do more. Any machinery which the engineering societies can create for defining the elements that should enter into the training of a young engineer and for bringing their definitions vigorously before engineering school faculties will be of undoubted service.

Engineers and teachers of engineering students must see more of each other. It is true that many teachers of the so-called "engineering subjects" are members of the engineering societies and rub elbows at occasional meetings with engineers—to the mutual benefit, I believe, of both groups. But it is just as necessary that the teachers of cultural subjects who are called upon to train engineering students should know something of the aims and ideals of the great profession. The absence of their names from the rolls of the Society for the Promotion of Engineering Education is but one indication of their lack of interest in the profession for which they are training young men. The line between the inside and the outside must be broken down; it is only by the mutual understanding and co-operation of the internal and external agents that the best type of engineer can be produced and the high standards and ideals of the profession be maintained.

Clays and Shales of Minnesota Inventoried

In order to establish the extent of the presence in Minnesota of clay suitable for the manufacture of brick, a survey of the clays and shales was recently made. The results are given in a full report just published by the United States Geological Survey. The geologic formations of the state and their clay deposits are briefly described, the general distribution of the several types of clay is shown, and the detailed distributions of the clays of the state are described by counties. The motive for the survey was to ascertain the extent of certain deposits that are now utilized at only a few places, to find new deposits, to determine the supply of brick clay available for every town of 1000 or more inhabitants in the state and for every county and to determine the qualities of the clays in the deposits and of certain mixtures in order to find whether it is possible to make from them refractory wares, pottery, paving brick and other high-grade products. The work was done by Frank F. Grout, author of the report, and other members of the Minnesota Geological Survey, in coöperation with the U. S. Geological Survey.

Heavy Foundation Work for Bascule Bridge at Seattle

Deep Pile Foundations and Hard Ground Carry Pier Footings — Piles Driven Below Water Without Follower—Tremies Place Concrete in Caissons

By F. A. Rapp
City Bridge Engineer, Seattle, Wash.

TWIN massive concrete blocks about 65 x 40 ft. in horizontal dimensions and over 20 ft. thick constitute the substructure of each of the two piers of a trunnion bascule bridge at Seattle, Wash. A special feature of the work is that deep pile foundations were required one side of the channel, while on the other side the foundation concrete rests directly upon firm material. A view of the foundation work is shown in Fig. 1. This bridge, carrying Eastlake Ave. over the Lake Washington Canal, is of the double-leaf type, with a span of 218 ft. between centers of trunnions. Its superstructure formed the subject of a separate article in the April 8 issue.

It will be seen by the plan, Fig. 2, that the substructure on each side of the canal consists of the two concrete blocks mentioned, each surmounted by a footing parallel with the axis of the bridge. Each footing carries a trunnion pier at the channel end and an anchor pier at the shore end. Deep transverse girders of reinforced concrete between these piers give lateral stability to the structure. Upon the two channel piers rests the steel cross-girder carrying the trunnion bearings, while built into each anchor pier is a structural steel column which takes the uplift of the tail of the bascule leaf. In section, the trunnion piers are 17 x 13 ft. at the footings and 8 x 9 ft. at the top, while the anchor piers are 17 x 10 ft. and 7 x 5½ ft. at bottom and top respectively. The height above footings is 80 ft.

These piers are inclosed and masked by a concrete structure of architectural treatment which resembles a massive bridge pier or abutment. The design of the south pier is shown in Fig. 3. This is in soft material and sand, through which piles were driven by the aid of water jets to reach a bed of hard clay at depths of 40 to 65 ft. below the bed of the canal or 77 to 102 ft. below the water level. The construction on the north side is similar, except that here the concrete foundations

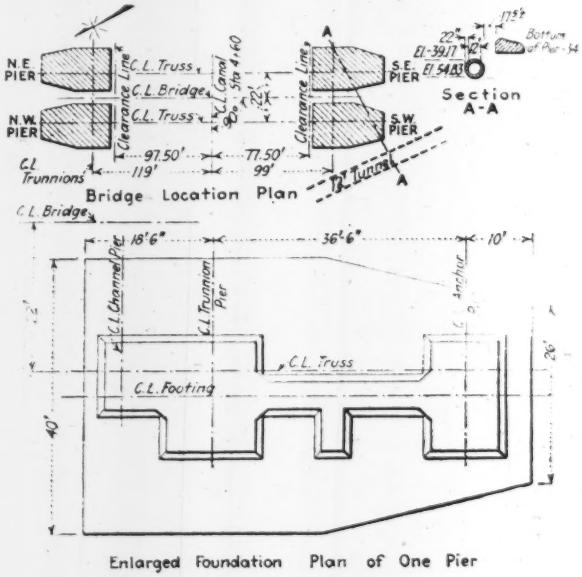


FIG. 2. LOCATION PLAN OF BRIDGE PIER FOOTINGS AND WATER TUNNEL

rest on hard material at an elevation of about 45 feet below datum or 53 feet below the water line. This material is coarse gravel cemented with clay which affords

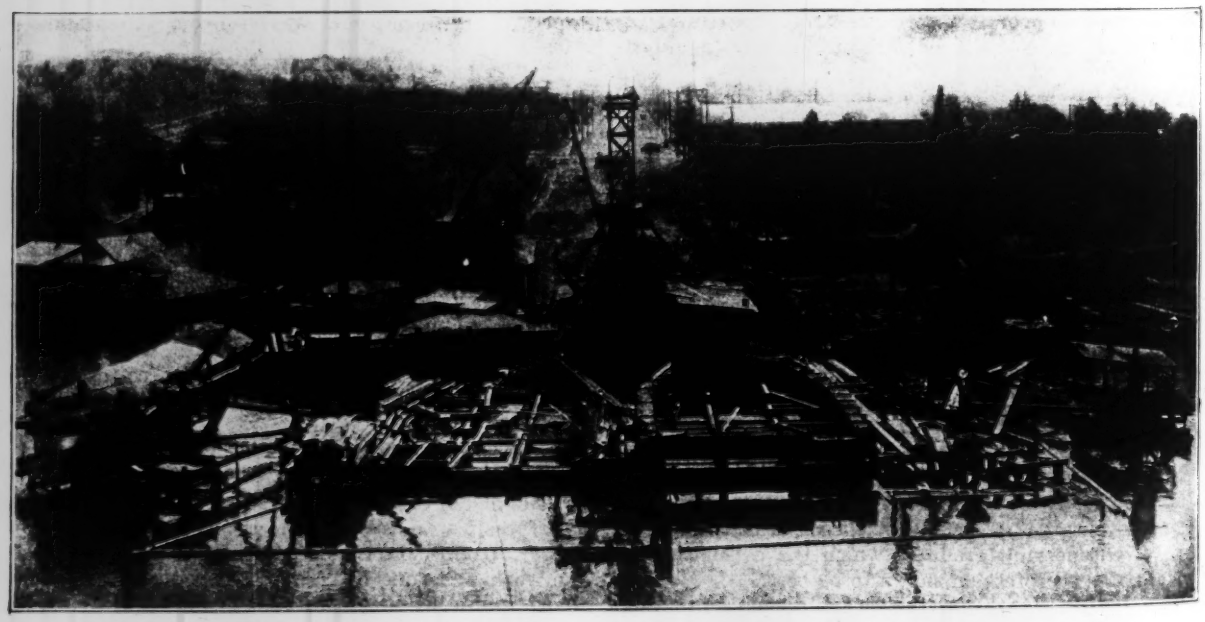


FIG. 1. CONSTRUCTING TWIN FOUNDATIONS FOR PIER OF BASCULE BRIDGE AT SEATTLE, WASH.

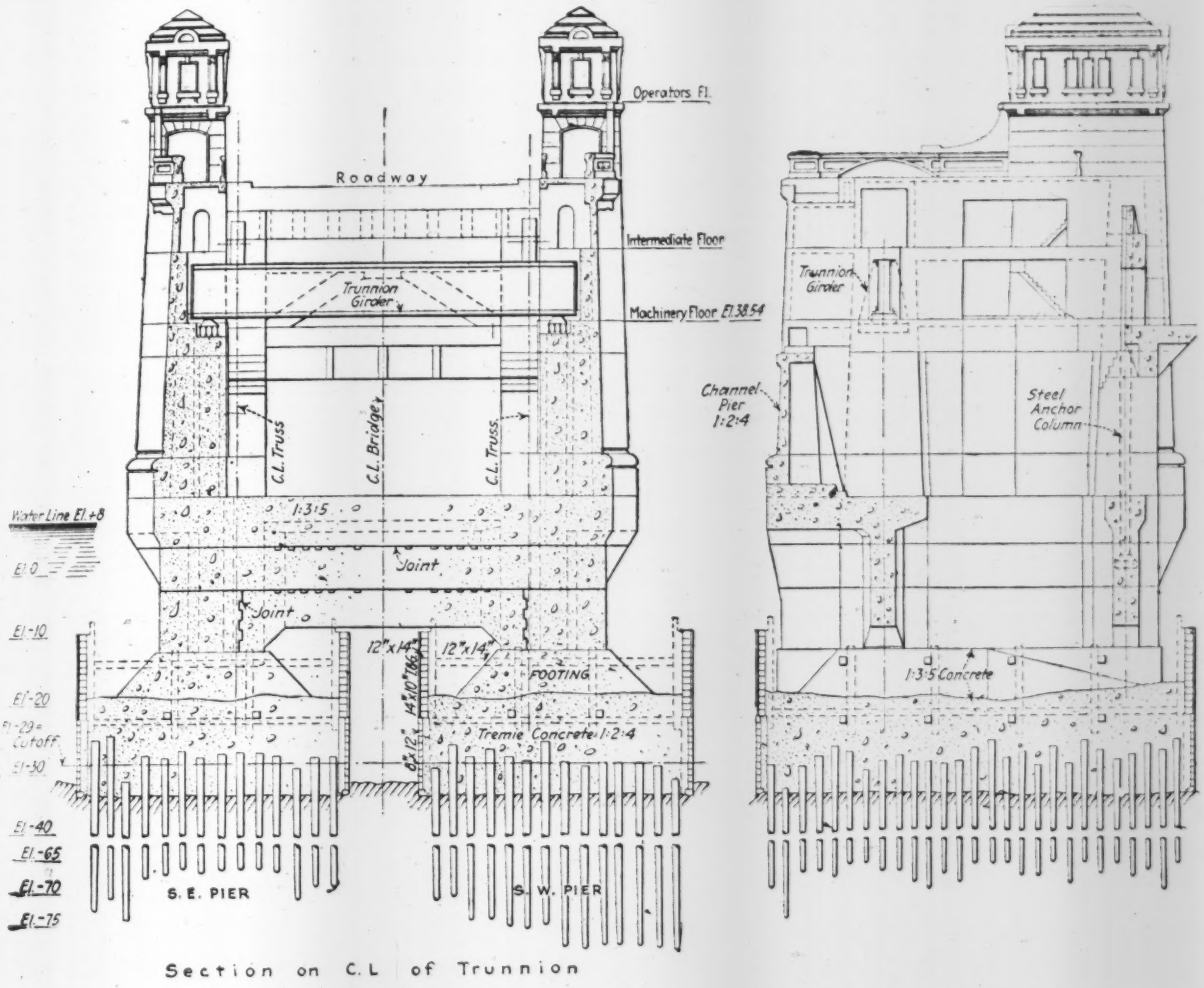


FIG. 3. PIER AND FOUNDATIONS FOR EASTLAKE AVE. BASCULE BRIDGE

ample bearing strength. Loading tests were made on three test piles driven in the foundation area. The first of these had a penetration of 44.4 ft., of which 17 ft. was in a light (almost floating) deposit of vegetable material, leaving a net penetration of 27.4 ft. in solid material. A test load of 54 tons was applied. Settlement during loading amounted to 0.057 ft., with a further settlement of 0.015 ft. in 55 days, as follows: 0.008 ft. first 52 hours; 0.006 ft. next 48 hours, with no additional settlement for 18 days. Some time during the next 23 days a further settlement of 0.001 ft. took place, after which no more settlement was found during 10 days. If the elastic deformation of the unburied portion of the pile is deducted, there is left a net settlement of 0.042 ft. This pile was driven by jetting and hammering, the jet penetrating to about the tip of the pile.

Test pile No. 2 was driven in a similar manner, except that the jet penetrated 1.5 ft. further than the pile and softened the material. The total penetration was 47 ft., with 9 ft. in the soft vegetable matter, leaving a net penetration in solid material of 38 ft. The applied load was 52.1 tons. Settlement during loading, 0.027 ft.; this remained constant for seven days, when an additional settlement of 0.001 ft. was observed on the tenth day after loading. No further settlement was measured in the next 46 days. The elastic deformation on this pile, figured similarly to the preceding, was 0.024 ft., leaving a net settlement of 0.003 ft. On the assumption that this pile is supported by skin friction on the area of the surface of the pile embedded in solid material there results a load of 840 lb. per square foot of such surface.

Test pile No. 3 was driven and jetted like the others, the jet in this case penetrating 5 ft. below the lowest point of pile so that the material was much worked. Total penetration 41 ft., all in solid material. Under the load of 52.1 tons the total settlement two days after loading was 0.015 ft.; this increased to 0.017 ft. after five more days, when it remained constant for 13 days. It showed a total of 0.018 ft. in 43 days after loading, with no increase up to 56 days. Figuring the elastic deformation in the same manner as before at 0.014, leaves a settlement of 0.004 ft. Calculating the skin friction under total load, this amounts to 720 lb. per square foot.

A water-supply tunnel of circular section, with an outside diameter of 15 ft. 8 in., crosses the lake at this point and has its top 5 ft. below the bottom of the footings, as shown in Fig. 2. It makes an angle of

about 25° with the axis of the bridge and at the nearest point is 17.5 ft. from the south pier. Transit sights were placed and levels taken, but continuous observations made during the progress of the piledriving showed no measurable displacement of the tunnel.

Foundation piles were placed by driving and jetting, the piledriver being mounted on a timber framework. Instead of using a follower, the drophammer was worked under water, moving in a guide tube which enclosed the pile. Excavation to the approximate level of the footings was done by a hydraulic dredge and then each of the piers was enclosed with a line of piles capped by a 12 x 12-in. timber. On these caps was laid out a system of longitudinal and transverse range lines whose intersections indicated the location of the foundation piles. The piledriver was mounted on stringers on this framework.

In all, 676 piles, ranging in length from 28 ft. to 62 ft., were driven to the desired depth in 45 days. The length of each pile was obtained by sinking a water jet to the hard stratum and making a measurement of the penetration. The piles were so accurately driven that the cribs or open caissons were sunk in place without striking any piles, although the centers of the outer piles were within 20 in. of the outer edge of the footing. The piles were delivered on the lake in rafts and handled to the driver by a stiff-leg derrick mounted on piles at one side of the foundation.

Caisson Construction

Construction of the caissons for each pier was started at a wharf on the north shore of Lake Union, which served as a framing yard. Material was handled from the wharf to the caissons in the water by a stiff-leg derrick mounted on piles driven alongside the location of the north piers. This derrick was designed and located also for use in handling concrete materials, etc., in the later stages of the work. The lower portions of the caissons were floated into approximate position at each pier site, finished in place, and sunk into final position by weighting with gravel disposed in boxes around the upper rim of the caisson.

These caissons follow the usual type of construction. The sides of the lower portion containing the seal are made up of 8 x 12-in. timbers on edge with 12 x 12-in. interior braces placed about 6 ft. apart vertically and about 13 ft. horizontally. The lower portions of the walls of the unwatered portion are made up of 12 x 14-in. timbers laid close on the 14-in. sides, with the interior braces about 4 ft. apart on centers vertically. This latter distance gradually increased to about 6 ft. near the water surface, where the side-wall timbers are reduced to 12 x 12-in. That portion of the caissons above a line about 6 ft. below the top of the seals was covered with 4 x 10-in. tongue-and-grooved sheathing. Above a line about 20 ft. below the water surface this sheathing forms the side walls of the caissons, backed by 12 x 12-in. wall timbers about 4 ft. apart on centers, increasing to about 6 ft. at the water surface.

After the caissons were sunk into position it was found that about 2 ft. of fine clay had slipped into the foundation of the north piers and 3 or 4 in. of silt in the south pier excavation. This was removed in both cases by means of a sand pump manipulated on the bottom by a diver.

Concrete placed under water by means of tremies was used to seal the caissons, the seal at the north piers being about 23 ft. thick, with bottom of footing 51.5 below the surface of the water. At the south pier caissons the seal was 15 ft. thick, with the bottom of footing 43 ft. below the surface of the water. All tremie work was done in a continuous operation, except for a few temporary breakdowns. A total of 6,493 cu.yd. of 1:2:4 concrete was deposited in 261 hours gross time by means of two 1-yd. mixers discharging by spouts to a 10-in. tremie, giving an average rate of deposition of 25 cu.yd. per hour. It was found that concrete that would flow readily in metal spouts inclined 1 on 3 would flatten out and flow for a distance of 30 ft. at a slope 1 on 6.5 under water.

During the placing of tremie concrete careful soundings were taken every few hours to ascertain if the concrete was flowing over and around the bracing timbers which it was necessary to leave in the lower portions of the caissons. It was necessary on this account, from time to time, to lift the tremie and place it in another pocket. This was done, however, before the concrete in that pocket had reached its initial set. Some laitance was always found at the foot of the slope, and it was the endeavor to keep the foot of the slope at the sides of the caisson and carry the laitance up with the work by keeping the tremie always well buried in the concrete. Examination after the caissons were unwatered disclosed hard, dense concrete without any lamination except in some small spots and on the toe of the southwest pier.

The caissons were usually unwatered about two weeks after the placing of the seals. Three days after unwatering the southwest pier the north end of the caisson lifted, opening a joint of about 1 in. at the line of junction between the lower 8 x 12-in. uncalked timbers and the 12 x 14-in. calked timbers. A small amount of the seal concrete was lifted over a joint that marked the deposition of concrete to level up the seal on top of some concrete that had apparently reached an initial set. Drill holes were put down all over this area and grout forced in through pipes until the joint was filled satisfactorily.

Concrete material was delivered on barges to the side of the plant, whence it was handled by a grab bucket swung from the derrick in rear of plant to hoppers over the mixers. From these hoppers the sand and gravel descended by gravity to the measuring hoppers, one for each mixer, on each side of the hoisting tower. The cement was passed in and added on this level, water being added as the materials were dropped into the mixers immediately back of the hoisting tower.

Both mixers discharged into a common central chute emptying into a self-dumping hoisting bucket in the tower. The concrete was deposited at any point of each pair of piers by a chute from the tower hopper into which the hoisting bucket emptied. This hopper was adjustable for height to accommodate the rise in the plane of deposition as the work progressed, and to secure the necessary slope of the chute to reach all parts of the work.

This substructure work for the Eastlake Ave. bridge was completed in 1918. It was in charge of the writer, under the direction of A. H. Dimock, city engineer. The architectural design was worked out by D. R. Huntington, city architect. The firm of Booker, Kiehl & Whipple, Seattle, Wash., was the contractor.

Hudson Vehicle Tunnel Designs and Bidding Methods

Chief Engineer Holland, in Sharp Rejoinder to General Goethals, Condemns Latter's Reasoning on Comparative Strengths of Different Designs—Bids on General Specification of Size and Location Not Competitive

IMPORTANT questions of engineering and construction methods raised by the recent memorandum of General George W. Goethals on the Hudson River vehicle tunnel (*Engineering News-Record*, April 8, 1920, p. 729) are treated in a reply to that memorandum prepared by C. M. Holland, chief engineer to the Joint Interstate Tunnel Commissions, under date of April 5. This reply, which bears the endorsement of four members of the Board of Consulting Engineers (Colonel W. J. Wilgus, J. A. Bensel, Wm. H. Burr, J. V. Davies), is reprinted herewith in slightly condensed form.

Dealing with the subject of shell strength, the reply lays emphasis on the stresses produced by excess ground pressures during construction when only part of the material is taken in during the advance of the shield. It condemns gravel packing for filling the space back of the shield tail, as unworkable under Hudson River conditions. It criticizes General Goethal's method of computing tunnel stresses; tunnels which proved weak in practice would by this method be shown to be safe. With respect to flotation, the risk of disintegration of the mortar in the joints between the concrete blocks, and cost of construction, it reasserts the position taken in the chief engineer's report on tunnel plan (*Engineering News-Record*, Feb. 19, 1920, p. 357), and in the statements of Mr. Holland and Colonel Wilgus on the Goethal's plan (March 25, 1920, p. 624).

A new point is brought up in comment on the proposal that bids be asked on general plans of capacity and location only, so as to secure contractors' bid figures on various types of tunnel. This proposed method is declared to be impossible, and to fail to produce comparable and competitive bids; it "would only lead up to hopeless confusion without any possibility of making an award."

Two-Level Tunnel Abandoned for Twin Tubes

The outstanding features of the communication from General Goethals are the abandonment by him of the plan he has heretofore advocated of a single, two-level tunnel, 42 ft. in diameter with 22-ft. 6-in. roadways, which has been under discussion, and the proposal to undertake the construction of the tunnel by unusual methods, with the elimination of engineers and the substitution of contractors, with a further proposal in regard to the choice of bids which is impossible of execution under the law.

It is now proposed by the communication in question to substitute twin tubes, 36 ft. 6 in. in diameter, with a 25-ft. roadway in each tube. The change of plan providing twin tubes 36 ft. 6 in. in diameter is accompanied by the same statements of great savings with which the single-bore 42-ft. tunnel was originally submitted, and no detailed information is now submitted which in any way changes the opinions which have already been given to you in regard to the defects of the plan of construction which is still adhered to, namely, the use of the loose concrete blocks for the tunnel envelope, the severing of Watts St., the pocketing of traffic in Canal St., the occupation of valuable waterfront property, and the exposure of the top of the tunnel at the 50-ft. U. S. improvement plane.

The complete absence of detailed information as to how the estimate of cost for the twin tubes is arrived at leaves the question of cost as indeterminate as it was before, but I submit that, even if the loose concrete-block tunnel could be built, twin concrete-block tubes, 36 ft. 6 in. in diameter would certainly cost more than the twin cast-iron tubes, 29 ft. in diameter, as recommended to the commissions in my report of Dec. 31, 1919.

In the communication in question, General Goethals has referred to a certain type of brick tunnel built a number of years ago and now forming a part of the Hudson tubes. It may be said in relation to this, without going into detailed explanation, that whatever this method of building tunnels was, it has been abandoned, and the fact remains that it was not succesfsul either as regards a structure or as a method of tunneling, and the completion of the tunnel was dependent upon execution of the same by the shield, with a cast-iron lining.

General Goethals, in the communication in question, still adheres to the necessity for three lines of travel in each direction. He has, however, changed the width of roadway from 22 ft. 6 in. to 25 ft., which latter width is still insufficient for three lines of traffic. He neglects, as heretofore, to show how three lines of travel can be accommodated in the street systems serving the tunnel.

Pressures During Tunnel Construction

General Goethals, in discussing the loads coming upon the tunnel, is not properly informed as to the conditions attending tunneling operations under the Hudson and East Rivers. He talks about the distortion which took place in the Pennsylvania tubes and will take place in any other shield-driven tunnel unless provision is made for the use of a filling material in the annular space around the tunnel as being due to the kinetic energy of the moving materials. The distortion could not be overcome by the ejection of gravel behind the shield. The distortion of the Pennsylvania tunnels and other tunnels built under similar conditions is mainly due to the pressures set up in the river bed itself when the shield is shoving without taking in the full amount of material. This is proved by the fact that the maximum distortion of the tunnel does not take place immediately upon leaving the tail of the shield but a considerable time thereafter. As another evidence of General Goethals' complete ignorance of conditions to be met in driving the tunnel, he states that this distortion has made it necessary to support the interior of the tunnel by vertical timbering and horizontal tension members. The method of support which he proposes instead of helping would greatly increase the distortion.

Gravel Packing Behind Shield

General Goethals states that the safe construction of the proposed concrete-block tunnel involves improved methods that result in the tunnel being built to the actual outside diameter created by the shield in its travel forward so that the surrounding material is not allowed to move and is constantly supported as the shield moves forward. By these methods, he probably refers to the proposed ejection of gravel, which experience has shown would not be workable under Hudson River conditions; so, as far as this feature is concerned, the method of construction for the concrete-block tunnel would necessarily have to be the same as that heretofore used for the cast-iron tunnels. If the pressure diagrams of the Pennsylvania tubes taken months after their construction give the forces which it would be expected would come upon the concrete-block tunnel, it would be essential to excavate all the material instead of displacing it, a method of construction which increases progress and thereby reduces the cost. Unless this is done, the disturbance of the material pushed aside would cause greatly increased pressures on the tunnel ring.

It is distinctly interesting to have General Goethals try to tell about the great advantages to be obtained by forcing gravel under high pressure into the annular space left by the shield, with the statement that, "The use of this gravel

packing is not the result of theorizing, but one of hard-headed practical experience and amply demonstrated as to its effectiveness through continued use by practical tunnel builders." This method was introduced and used in connection with the construction of the land portions of the East River tunnels. (It was not used under the river, as has been erroneously stated.) These tunnels were constructed under the direction of your chief engineer while Tunnel Engineer for the Public Service Commission and it was under the direction of the engineers of his staff that the methods were made practicable and workable. The advantage to be obtained by this method may therefore be assumed to be equally well, if not better, known to your engineers as to General Goethals.

Tunnel Shell Stresses

General Goethals states that we have applied assumptions to the concrete-block tunnel in analyzing the stresses in it, which will also show unsafe stresses in the cast-iron tunnel if applied to it similarly. He further states that, "these assumptions applied to a block tunnel for a material having a stiffness expressed by an angle of repose of 13°, leads to results that indicate the unsafeness and structural defectiveness of the block tunnel." Also, he states that for this same condition of loading he calculates the tension in the cast iron to be 9,800 lb. per sq.in. This stress is far within the modulus of rupture of the cast iron used in tunnel lining, and therefore, in accordance with his own analyses, the concrete-block tunnel is not comparable with the cast-iron lining under the same conditions of loading. His analyses check the results of those made in this office, in that the active forces represented by the materials show that under the most ideal assumptions for the perfect fitting of the block and shape of the ring the concrete-block ring would be utterly destroyed by such forces, while the cast-iron ring would be heavily stressed, but far from the point of failure.

It is not contended by your engineer that the analyses, based on the assumptions, give definite stresses but that they only afford comparable studies under assumed ideal conditions which are never realized in practice and which even General Goethals admits are indeterminate.

General Goethals states that "The individual voussoir blocks making up the concrete tunnel ring are bolted one to the other throughout the length of the tunnel. These bolts perform the same function as do the bolts used in bolting up the rings of the cast-iron tunnels." This statement is not true, as the bolting provided in the concrete-block construction serves only to tie adjacent rings together, without any bolting between individual blocks in the same ring, as is provided in the cast-iron ring recommended by your engineers. The fundamental difference between the concrete-block ring construction and the cast-iron ring construction is that one ring of blocks cannot stand up without the support of the adjacent rings of blocks, whereas each cast-iron ring is self-supporting.

General Goethals states that he has applied the normal pressure formulas as checked by Pennsylvania pressure diagrams to the 42-ft. concrete-block tunnel, the 29-ft. cast-iron tunnel and the Pennsylvania tubes and he gives the stresses obtained in the various tunnels by this method, which he claims is the proper method for analyzing the strength of the tunnel ring and on which basis he finds that the 42-ft. concrete-block tunnel ring is safe. If this method of analysis were applied to tunnels which experience has shown to be insufficient to withstand the pressures under the Hudson River, he would most certainly find these tunnels safe. The old Hudson River tunnels, which proved inadequate to stand the strains imposed upon them, would figure safe under this assumption; the Pennsylvania R.R. "light iron" tunnels would figure safe under this assumption. This light-iron tunnel of the Pennsylvania R.R., however, was by actual experience found to be insufficient in strength and a heavier lining was substituted and used for the entire length of the North River tunnel through the silt. These tunnels were completed in 1907 and as late as 1911, after all the experience gained in driving these tunnels was perfectly digested and understood, General Charles W. Raymond, Chairman of the Board of Engineers of the Pennsylvania Railroad Tunnels, made this statement: "The main reason, however, for increasing the thickness of the lining was, if my memory is correct, to strengthen it to resist the strains to which it would be subjected during construction. In view of the fact that a number of plates were cracked during construction this now appears to have been a very wise precaution."

Which Tunnels Would Float

Discussing flotation, General Goethals states that "Provided the material had no cohesion, it is true theoretically that the block tunnel would float as stated by your engineers. But why conveniently apply this condition only to the concrete tunnel? The same reasoning shows that not only would your proposed 29-ft. cast-iron tunnel float during construction, but likewise the existing Pennsylvania R.R. tunnels would have floated." Special precautions can be taken to hold a tunnel down during construction, but it is the permanent condition of the tunnel which is a matter of concern. Comparing the completed structures of the 42-ft. tunnel, the Pennsylvania R.R. 23-ft. tunnel and the 29-ft. tunnel recommended by your engineers, it is found that, for the condition where the 42-ft. tunnel would float, at 3° 50′ as well as for any other condition, the Pennsylvania tubes and the 29-ft. tunnel have a much less tendency for flotation than the 42-ft. tunnel. * * * * The concrete-block tunnel 42 ft. in diameter weighs 71,740 lb. per lin.ft., while it displaces 88,670 lb. of water, and when it is remembered that the silt is in almost a fluid condition at the bottom of the river, it should be apparent to any ordinary man that the tunnel would be in serious danger of flotation. The 29-ft. cast-iron tunnel, completed with its lining, is actually heavier than the water it displaces.

Grouted Joints Not Watertight

General Goethals states "All joints between blocks of the concrete tunnel are so designed that they can be readily filled with cement under pressure throughout the area of their faces. To say that this tunnel cannot be made watertight is to ignore the actual accomplishment of the result in tunnels of this character built and building." General Goethals apparently has not studied the photographs of the tunnels to which he refers, for if he had it should be apparent that watertightness has not been secured, although the materials through which the tunnels have been built are not in any sense comparable to the water-bearing ground under the Hudson River. *Watertight joints cannot be obtained by the grouting methods which General Goethals proposes.*

General Goethals states that he bases his estimate of $12,000,000 for the 42-ft. concrete-block tunnel, which he has now abandoned, upon the experience of the O'Rourke Engineering Construction Co. in work of this character, who report such figures from the imagined cost of their patented type of construction, for which there is no basis as it has never been tried under conditions similar to those to be met with under the Hudson River. This estimate differs from all the figures in regard to construction cost for tunnels already built, and the Chief Engineer and the Board of Consulting Engineers have reported the cost to the commissions based on detailed analyses of costs derived from actual experience in building existing tunnels in this locality.

Proposed Method of Bidding Impossible

General Goethals criticises the commissions for not having followed his recommendation, and states that, had his recommendations been followed, definite data as to costs could have been obtained over a year ago, and immediately thereafter the type of tunnel settled and construction commenced. General Goethals must know that the method he recommends is absolutely impossible. He states, "My recommendation was to invite definite bids from the three or more large engineering construction concerns experienced in tunnel construction." Such a procedure would be entirely improper in letting public work, for the commissions cannot select bidders. He further proposes that "these bids be limited only to tunnels having a certain width of road-

way, and for the location Canal St. to 11th St. The type of construction, single or twin tunnels, was to be left open and the bidder was to be invited to submit *bona fide* bids on concrete-block, cast-iron and open-trench types, and time required to build." This would be impossible of procedure as it would not afford comparative bids, and would not be competitive bidding as required by law. In fact, all the commissions would obtain would be the assertions of contractors, without any possibility of a determination of the relative merits of the different bids.

Next he proposed that "The bidder would be required to submit detail plans on which his bids were based, and for which actual cost of preparation would be paid upon rejection." This would be an entirely unexampled procedure of paying contractors for the submission of their designs, and would land nowhere.

Again, he proposed that "The bids would be based on general specifications only, and the bidder was to be required to furnish ample bonded security to protect the commissions and place full responsibility on the prospective contractor." Bids based on general specifications would not be on a comparable basis.

Taken altogether, the recommendation of General Goethals as to method of procedure shows an absolute lack of knowledge in regard to what is required in the public letting of contracts, which in brief require a sufficiently developed plan so that bids may be compared based on that plan. In other words, every plan on which bids are asked must be developed to the extent of making it possible for the engineers of the commissions to make a comparative estimate, from which the low bidder may be determined, and any departure from this plan would only lead up to hopeless confusion, without any possibility of making an award.

The law requires that you should have a competitive bid. The only way that you can have a competitive bid is by a request to have a bid on a definite plan of construction. General Goethals' scheme involves the abandonment of this procedure and is not worthy of any consideration whatever.

Alleged Saving of Cost

General Goethals in conclusion states that, "The paramount question still remains: Will your commissions, simply because fearful of attempting something which heretofore has not been tried out in its entirety, recommend the expenditure of 26 to 30 millions to create facilities for vehicular crossing of the North River, when 10 to 12 millions less than this amount will accomplish the desired end?"

On one side the commissions have before them a carefully prepared plan and estimate, and on the other side, a statement from General Goethals which he confesses is based on assertions of cost given by a contractor for a method of construction which has never been used under conditions similar to those which are to be encountered in building a tunnel under the Hudson River. No basis has ever been submitted to the commissions by which they could judge in any way of the adequacy of the figures which have been given. There can be no fact, no assurance, because the methods proposed are entirely unknown and have never been used under conditions governing the construction proposed, and are altogether in a field of conjecture and outside of any definite experience in subaqueous tunnel construction; and the assertion that the proposed methods of construction would save 10 to 12 millions can be accepted, if it is desired, but a study of what has been submitted leads your engineers to maintain that, not only would 10 to 12 millions not be saved, but that whatever money was expended in this experiment would simply be wasted, and the whole undertaking would end in disaster.

Respectfully submitted,

C. M. Holland,
Chief Engineer.

Approved:
W. J. Wilgus,
Chairman, Consulting Board;
J. A. Bensel,
W H. Burr,
J. V. Davies

Fires in Treated Bridge Floors

INVESTIGATION of three bridge-floor fires has been made by a committee reporting at the recent annual meeting in Chicago of the American Wood Preservers Association. The object was to determine whether the use of treated timber had increased the fire hazard.

The Belle Isle bridge in Detroit was destroyed May 1, 1915. The floor was of 3½-in. creosoted blocks laid on 4-in. plank, supported by 4 x 14-in. joists, all creosoted. The commonly accepted theory of the origin of the fire is that a strong wind carried sparks from a municipal asphalt-repair wagon to dry, untreated and partially decayed sidewalk timbers where they were finally fanned into flames. The wind rapidly communicated the flames to the creosoted timber substructure from which it spread without hindrance.

Sparks from an engine passing under the Missouri River bridge of the Union Depot Bridge & Terminal R.R. at Kansas City in August, 1919, set fire to a large bird's nest of straw on the under side of the bridge. The fire was communicated to the creosoted ties and 2-in. longitudinal planking laid on the ties to form a motor-way for automobiles. There is no water line on the bridge and it was 45 min. before sufficient hose could be laid from the city mains to reach the fire. By not allowing the firemen to tear up the planking, thereby creating a draft, the fire was kept in a smoldering condition underneath the planking, and easily put out in 15 min. by playing the fire streams from below. Surface charring of the timbers was caused by the burning of the creosote. The replacement of a few planks along the edges was the only repair work done.

Several years ago a fire of unknown origin on the same bridge but not near the undercrossings gained great headway because the firemen tore up the planking ahead of the fire in an attempt to cut it off. This created a draft and increased the spread of the fire causing a loss of 600 ft. of bridge flooring and such severe twisting of the rails and steel floor beams as to require their renewal.

At Portland, Ore., on July 30, 1913, 430 ft. of the upper deck of a bridge belonging to the O. R. R. & N. Co. was burned, entailing a loss of $45,000 to $50,000. With the exception of the planking in the two sidewalks the entire floor system in the upper deck was made up of creosoted Douglas fir. The fire is supposed to have started on some untreated lumber located on the bottom chord of the lift span. In replacing that portion of the floor which was destroyed by fire, the railroad sheathed the under side of the timber in the upper deck with galvanized iron for the purpose of minimizing the possibility of another fire. The railroad subsequently placed asbestos boards on the under side of all timber in the upper deck not covered by galvanized iron.

Warm Springs Dam Not Constant-Angle Type

In the description of the Warm Springs dam in the *Engineering News-Record*, March 4, 1920, p. 474, it is erroneously stated that the structure was designed according to the constant-angle arch theory as propounded by L. R. Jorgensen. A. J. Wiley, consulting engineer for the Warm Springs Irrigation District, states that the dam is the ordinary type of constant-radius arch dam.

Federal Engineers Classified As To Duties and Pay

Keating Commission Submits Report to Congress Covering All Government Employees at Washington

DEFINITE recommendations governing the reclassification and compensation of Federal Government employees at Washington, D. C., including those in the various engineering and scientific branches of the service, are contained in the report of the Keating Commission, which was recently presented to Congress and which represents the results of about a year's investigation. The commission was formed by legislative act in 1919 to study the rates of compensation paid to civilian employees in the various government departments in the District of Columbia and to draft a bill providing for carrying out such changes in classification and compensation as might be recommended. In all, 107,000 employees have been classified at an estimated cost of $275,000; of this number about 2,600 are engineers.

The report specifies 1,700 classes of service, presents figures covering maximum and minimum compensation in each class, and contains recommendations as to promotions, both within classes and from one class to another.

The portion of the report dealing with the Engineering Service follows:

Engineering Service

This service includes classes of positions, the duties of which are to supervise or to perform work involving the application of the principles of science to the design, construction, operation, maintenance and valuation of public works; to the generation, distribution and utilization of electrical energy; to the design and construction of ships and aircraft; to the design and construction, maintenance and operation of prime motors and machinery; to the extraction of minerals and petroleum from the earth and their conversion to industrial use; to the conservation and development of forest resources and wood products, or to other specialized lines of engineering activity.

Aeronautical engineering
Automotive engineering
Cadastral engineering
Cartographic engineering
Ceramic engineering
Civil engineering
Classes common to all engineering series
Electrical engineering
Forestry
Highway engineering
Hydraulic engineering
Hydrographic and geodetic engineering
Landscape architecture
Marine engineering
Materials engineering
Mechanical engineering
Mining engineering
Nautical engineering
Naval architecture
Ordnance engineering
Petroleum engineering
Radio engineering
Structural engineering
Topographic engineering

Note: The commission has not placed architects and chemists under the engineering service. Each group, such as aeronautical engineering, automotive engineering, etc., is divided into classes. Some of the groups, such as cadastral engineering, do not contain the full number of classes found under civil engineering. The group specifications, lines of promotion, and compensation for civil engineering are given below.

CIVIL ENGINEERING

Title of Class:
CIVIL ENGINEERING DRAFTSMAN

Specifications of Class

Duties: To perform, under immediate supervision, routine drafting work in connection with the preparation of plans for civil engineering projects; and to perform related work as required.

Examples: Making tracings from original drawings; making drawings of minor importance; filing and indexing drawings; lettering, computing and revising.

Qualifications: Training equivalent to that represented by graduation from high school; not less than two years' experience in engineering drafting work; and ability to letter and to make simple calculations.

Principal Lines of Promotion

From: Copyist draftsman.
To: Junior civil engineer.
Compensation for Class, $1,200-1,800.

Title of Class:
CIVIL ENGINEERING AID

Specifications of Class

Duties: To perform, under immediate supervision, minor technical work in any branch of civil engineering; and to perform related work as required.

Examples: Making measurements and estimates in the field; acting as recorder or computer in laboratory, field, or office; operating and caring for surveying instruments; computing data for reports or records; plotting notes and maps; preparing working drawings where design is furnished.

Qualifications: Training equivalent to that represented by graduation from high school; not less than two years' experience in engineering work; familiarity with the use of the slide rule; and ability to do lettering and drafting and to make simple engineering computations.

Principal Lines of Promotion

From: Junior engineering aid.
To: Junior civil engineer.
Compensation for Class, $1,200-1,800.

Title of Class:
JUNIOR CIVIL ENGINEER

Specifications of Class

Duties: Under immediate supervision, to perform routine surveying, computing, drafting, and inspecting, on survey, construction, or valuation work; and to perform related work as required.

Examples: Surveying with transit or level; using measuring devices for stream gauging; inspecting structures during construction and after completion; assisting in laboratory tests of structural materials; preparing charts for statistical and engineering data; laying down lines for building foundations; drawings and tracing plans; making plane table surveys; developing and drawing details of maps and charts; lettering; giving line and grades for highway construction; keeping cost data serving as boat officer or as assistant in hydrographic, geodetic, and astronomic parties.

Qualifications: Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in civil engineering.

Principal Lines of Promotion

From: Civil engineering aid; civil engineering draftsman; cartographic draftsman.

To: Assistant civil engineer; assistant topograph engr.; assisant highway engr.; asst. hydraulic engr.; asst. hydrographic and geodetic engr.; asst. structural engr.; asst. cartographic engr.

Compensation for Class, $1,800-2,160.

Title of Class:
ASSISTANT CIVIL ENGINEER

Specifications of Class

Duties: Under specific administrative and technical direction, to be responsible for the conduct of the work of a minor subdivision of a civil engineering organization; to collect and compile data for specific items of civil engineering organization; to collect and compile data for specific items of civil engineering studies; to take immediate charge of field survey projects in, or of the design, inspection and construction of minor civil engineering work; to lay out and develop work from specifications and to supervise the work of a drafting or computing force; to conduct specific tests or investigations of apparatus, material, or processes; and to perform related work as required.

Examples: Directing field parties on construction, valuation, or surveys; superintending and inspecting construction work; performing the work of an office engineer; assisting the superintendent of an aqueduct or important water supply structure; testing materials, as steel or cement; preparing technical material for publication; investigating water-proofing of structures; compiling statistical data; compiling and analyzing costs of railroad materials and construction.

Qualifications: Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in civil engineering; not less than two years' experience in civil engineering work in field or office; proven technical knowledge and proficiency.

Principal Lines of Promotion

From: Junior civil engineer.
To: Associate civil engineer.

Compensation for Class, $2,400-3,000.

Title of Class:
ASSOCIATE CIVIL ENGINEER

Specifications of Class

Duties: To perform one or more of the following functions under general administrative and technical direction: (1) To be in responsible charge of an intermediate subdivision of a civil engineering organization. (2) To exercise independent engineering judgment and assume responsibilities in studies and computations necessary for the preparation of reports, estimates, designs, or valuations. (3) To have immediate charge of the construction, maintenance, or operation of important civil engineering works or projects. (4) To conduct or direct important lines of civil engineering research. To perform other related work.

Examples: Having immediate charge of the construction of water mains, sewers, streets, and other municipal work; testing engineering materials; making cost studies; supervising surveys of areas and acquisitioning of lands; laying out of railroad terminals, yards, and storage bases; estimating and expediting construction work and design.

Qualifications: Training equivalent to that represented by graduation with a degree from an institution of recognized standing with major work in engineering, preferably civil engineering; not less than five years' general engineering experience, of which at least one year shall have been in the direction or performance of important civil engineering work and supervisory or administrative ability, or a high degree of technical skill.

Principal Lines of Promotion

From: Assistant civil engineer.
To: Civil engineer.

Compensation for Class, $3,240-3,840.

Title of Class:
CIVIL ENGINEER

Specifications of Class

Duties: To perform one or more of the following functions under general direction: (1) To have responsible charge of, and to initiate and determine policies for a major subdivision of a civil engineering organization. (2) To prepare for final executive action, reports, estimates, designs, specifications, and valuation studies and data. (3) To have charge of the construction, inspection, maintenance, and operation of municipal or other civil engineering works of major importance. (4) To conduct or to direct major lines of civil engineering research. (5) To furnish for executive action, expert or critical advice on civil engineering works, projects, or policies; to act as advisor or consulting specialist on civil engineering problems. To perform other related work.

Qualifications: Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in civil engineering; not less than eight years' general engineering experience, of which at least four years shall have been in the direction or performance of important civil engineering work; large capacity and proven administrative ability.

Principal Lines of Promotion

From: Associate civil engineer.
To: Senior civil engineer.

Compensation for Class, $4,140-5,040.

Title of Class:
SENIOR CIVIL ENGINEER

Specifications of Class

Duties: To perform one or more of the following functions: (1) To have administrative charge of a civil engineering organization of a main division thereof, and to determine or execute general policies under the limitations imposed by law, regulations, or other fixed requirements. (2) To be responsible for reports, estimates, designs, specifications, and data, or for the construction, maintenance, and operation of large civil engineering works or projects. (3) To have full charge of the collection and presentation of data for, and the conduct of valuation proceedings. (4) To direct or to perform the most comprehensive research in civil engineering. (5) To act as consulting specialist on important civil engineering projects, policies, or valuations. To perform other related work.

Qualifications: Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in civil engineering; and not less than 12 years' general engineering experience, of which at least 8 years shall have been in the direction or performance of important projects in civil engineering work of a character to give substantial evidence of engineering knowledge and ability, or executive capacity of the highest order.

Principal Lines of Promotion

From: Civil engineer.
To: Commissioner of lighthouses; chief valuation engineer, Interstate Commerce Commission; supervisor of land appraisals, Interstate Commerce Commission; director and chief engineer, Reclamation Service.

Compensation for Class (Asterisk indicates Civil Service Commission will recommend).*

CLASSES COMMON TO ALL ENGINEERING SERVICES

Title of Class:
JUNIOR ENGINEERING AID

Specifications of Class

Duties: Under immediate supervision, to perform miscellaneous subordinate work in the laboratory, office or field, in any branch of engineering.

Examples: Setting up apparatus; making simple engineering computations; compiling field data or laboratory notes; filing and indexing maps; plans and notebooks; preparing samples; caring for instruments in the field or laboratory; working as rodman, chainman, or tracer; making blue prints.

Qualifications: Common-school education; good health.

Principal Lines of Promotion

To: Ceramic engineering aid; civil engineering aid; electrical engineering aid; materials engineering aid; mechanical engineering aid; mining engineering aid; materials aid.

Compensation for Class, $840-1,200.

Title of Class:
COPYIST DRAFTSMAN

Specifications of Class

Duties: Under immediate supervision, to make tracings from original drawings prepared by others; and to perform miscellaneous routine work in a drafting room.

Examples: Making simple tracings; copying data; filing and indexing under supervision; lettering; making simple drawings and diagrams; making hand corrections on printed charts.

Qualifications: Training equivalent to that represented by graduation from high school; knowledge of the use of drawing instruments, and ability to use them neatly.

Principal Lines of Promotion

To: Civil engineering draftsman; cartographic draftsman; electrical engineering draftsman; mechanical engineering draftsman; marine engineering draftsman; ship draftsman; aeronautical draftsman; automotive tracer; landscape draftsman.

Compensation for Class, $1,080-1,260.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Correspondence

Sir—I wish to express my sincere appreciation of the noteworthy article by R. Fleming upon the need of a history of engineering which appeared in your issue of Feb. 12, 1920, p. 322. What a splendid book that would be to place in the hands of graduate students, especially those who devote more than one year to graduate work!

It may be taken for granted that every teacher in any subdivision of engineering would be profited by reading such a history, since there is a natural tendency to over-estimate one subject in comparison with another. Would it be equally serviceable to engineers in practice?

It would doubtless be a difficult task to make a wise selection from the great mass of available material so as to keep the size of the book within reasonable limits, and also to retain elements of sufficient interest in the text to attract the younger engineers. The best results would very likely be secured by the co-operation of a number of authors.

While the demand for a history of engineering would be small, and would not therefore attract the attention of any publisher, the real need of it should enlist the active interest of the national engineering societies.

Ithaca, N. Y. HENRY S. JACOBY.

An Indian Engineer on Dam Design

THE DESIGN OF MASONRY WEIRS.—By S. V. Kanagasabai Pillai, Sub-Engineer, P.W.D., Madras. Address the Author, 1, Office Venkatachala Mudaly St., Triplicane, Madras, S. E. Cloth; 6 x 9 in.; pp. 201; illustrated. Rs. 4.

REVIEWED BY F. TEICHMAN

Consulting and Designing Engineer, Wollaston, Mass.

In India English engineers have developed the type of canal structure on sandy soil in which the head due to the difference of upstream and downstream water levels may be neutralized by the resistance to percolation. Such percolation is harmless if by proper length of structure it is reduced in rate to such a value that where the percolating current returns into the canal, the particles of the exit stratum are not carried away. W. G. Bligh, the nestor in this field of engineering, has given the profession two valued books dealing with the subject and now there is made a worthy addition to this literature in the form of "The Design of Masonry Weirs" by an Indian engineer, S. V. Kasagasabai Pillai. These three books by no means limit their discussion to weirs or dams on sandy soil, but they are of particular interest to the American engineer who has to build a weir or dam on pervious soil. Our own literature contains papers and discussions on this subject recorded in the *Transactions* of the American Society of Civil Engineers ("Action of Water Under Dams," by J. B. T. Coleman; "Designing an Earth Dam Having a Gravel Foundation," by J. B. Hays). The principle of neutralizing head by proper length of creep is generally accepted by the engineering profession but there are not many structures in America that are designed on that principle. The only data available to us as to the proper gradient (head to length of creep) for the design of a structure on pervious soil are those furnished by Mr. Bligh and merely repeated by Mr. Pillai. It is very desirable that the Indian and Egyptian engineers, when giving what they consider the proper gradient for the various grades of sandy soil, specify more closely the characteristics of the sand by stating the specific gravity, the voids, the effective size of the sand grain and the uniformity of coefficient. The writer feels that if such data were available to him his designs for the canal structures of a 130,000-acre drainage district in Florida could be made with more satisfactory results as to economy as well as safety.

Mr. Pillai has given much careful thought to his subject. He has developed formulas, tables and diagrams relating to weirs of triangular, rectangular, trapezoidal and pentagonal section, first without uplift then with uplift (reducing specific gravity of weir by one), and under various depths of overtopping water and of tail water. The formulas and tables give the required width of base with resultant at edge of middle third, and the location of resultant for a given section, and the incline of the resultant to the vertical. The author then establishes workable expressions and tables for that particular flood condition which will produce the maximum moment on the weir structure, assuming, to that end, values for the width, slope and roughness of the canal downstream from the structure. His method of analysis is applied to existing weirs and interesting diagrams visualize conditions. The practicable minimum sections of weirs are given and the method of determining the weir section by calculating the successive courses downward is illustrated. This is followed by an examination of existing weirs and by short chapters on hydrostatics and earth pressure.

The Indian weirs do not generally exceed a height of 20 ft. and the discussion does not enter upon the question of aeration under the jet or of adaptation of weir outline to the lower curve of the jet.

The book will be of value to the student and will be read with interest by the designer. However, after profiting by the presentation of the subject by Mr. Pillai, it is likely that the designer will prefer to make, in his own way, the determination as to that state of possible flood which will create the maximum stress on the structure, introducing the specific hydraulic conditions that surround his problem. After having established the critical forces, including the uplift suited to the condition and the specific gravity of the masonry, the designer is likely to determine the required section graphically or by calculating the successive courses, following the established procedure.

Concrete Building Estimates

ESTIMATING CONCRETE BUILDINGS.—By Clayton W. Mayers. Boston, Mass.: Aberthaw Construction Co. Cloth; 6 x 9 in. pp. 51; illustrated. $1.

This is a complete though condensed exposition of a method of estimating the quantities in a reinforced-concrete building, with examples carried out for a typical structure. It should be very much worth while to those who are not fully informed as to such practice.

It is announced that while a price has been put on the book, the Aberthaw Construction Co. will provide free copies to architects and engineers and to technical schools that may wish to adopt it for class room purposes.

An Intensive Commissioner-Manager Study

CITY MANAGER IN DAYTON: Four Years of Commission-Manager Government, 1914-17; and Comparisons with Four Preceding Years Under the Mayor-Council Plan, 1910-13—By Chester E. Rightor, B.A., Detroit Bureau of Governmental Research, etc.; in Collaboration with Don C. Sowers, Ph.D., Director, Akron Bureau of Municipal Research, etc., and Walter Matacheck, M.A., Secretary, Civics Department, Chamber of Commerce, Kansas City. New York: The Macmillan Co. Cloth; 5 x 8 in.; pp. 271; illustrated. $2.50.

Contrary to general understanding, "the favorable vote" for the Dayton commission-manager charter that went into effect on Jan. 1, 1914, "was not a consequence of the flood of 1913—it was merely subsequent to it." Thus do the authors open their interesting and useful discussion.

The book is an intensive study of the commission-manager plan, and especially of the city manager, in the city which is its leading exponent. The study has been made by men who were for some time on the scene and occupied vantage points, as the heading above indicates. That the authors desire to be impartial, their discussion shows, and that they are open-minded as to possible advances in city government may be inferred from the lines by Lowell at the head of their Preface:

> New times demand new measures and new men:
> The world advances, and in time outgrows
> The laws that in our fathers' day were best:
> And doubtless, after us, some purer scheme
> Will be shaped out by wiser men than we,
> Made wiser by the steady growth of truth.

What the next step forward—the "purer scheme"—in the framework of municipal government will be cannot well be discussed here, but a careful study of this volume would doubtless yield suggestions. Perhaps further improvement will come less from changes in the scheme of government than in its applications, both mental and moral.

The opening chapter, on "How Dayton Got Good Government," gives credit to John H. Paterson and other men of vision, to various civic and commercial organizations and committees and to the Charter Commission made possible by the Home Rule Amendment to the Ohio Constitution, adopted in 1912. A later chapter, on The City Manager at Work, brings out clearly how much the success of the plan at Dayton—and for that matter elsewhere—was due to Henry M. Waite, the engineer who served as city manager until he joined the American Expeditionary Force in France. But lest we unintentionally misrepresent the viewpoint of the authors, as well as the methods and spirit of Mr. Waite and the underlying principles of city managership, a paragraph from the book will be introduced:

> The success of City Manager Waite in Dayton was due not so much to the fact that he is a trained engineer, as he used his engineering knowledge but little—since he had trained engineers under him, and employed experts whenever occasion necessitated and justified,—but it was due to the fact that he appreciated and understood the public and was a master in the art of stimulating and controlling men. It was because he marched out with the baseball boys on opening day and pitched the first ball across; because he talked to small groups in various sections of the town on their pet hobby; because in his interviews with citizens who came to his office, he was able to send them away with a smile even though there may have been harsh words spoken in the conferences.

The idea suggested by the last sentence of the quotation is the subject of a chapter on Humanizing City Government, which shows how much and how well Mr. Waite did in that generally neglected field. Other chapters deal with Protecting Life and Property, Municipal Housekeeping, Purchasing for a City. In a chapter on Public Opinion attention is given to the opposition which the commission-manager plan has met in Dayton, particularly from the Socialists. Here there is some frank writing, and while much of it scores the Socialists for ignoring and misrepresenting facts some of it is on the other side—at least to the extent of stating that the opponents of the Socialists went too far in the 1917 election in making national affairs an issue. This chapter brings out the fact that although the Socialists polled 43 per cent of the votes cast for councilmen in 1917, and were defeated by a bare majority, they still continue to remain unrepresented in the Council—which is held to be an argument for some more truly representative form of election.

The volume closes with sample pages from the Dayton budget, including a detailed classification of accounting items, a consolidated balance sheet, and annual appropriations and expenditures by organization units.

Similar studies of a dozen each of (1) other commission-manager cities; (2) commission cities without managers; and (3) mayor-and-council cities, divided equally between those with and those without a fairly clear separation of legislative and executive functions, would be most welcome; but we fear that a program calling, as it would, for nearly two-score volumes, prepared by specialists with intimate knowledge of the respective cities yet so circumstanced as to be judges rather than partisans, would overtax investigators and publishers alike. To be more practical, therefore, we suggest two or three books in each class, or even one only in the two classes not yet covered.

Iron Bacteria and Water Supplies

IRON BACTERIA—By David Ellis, D. Sc., Ph.D., F. R. S. E., Royal Technical College, Glasgow. London, Eng.: Methuen & Co., Ltd. Cloth; 6 x 9 in.; pp. 176; illustrated. 10/6 net.

Life histories and the practical aspects of a half dozen classes of organisms that abstract iron from water and store it on or within themselves as ferric hydroxide are given in this interesting volume. The author states in his introduction:

> From the practical standpoint, a study of the habits and peculiarities of the iron bacteria is one which cannot be ignored by those engineers and chemists whose work lies in the supervision of water reservoirs. Some of the iron bacteria occasionally multiply to an extraordinary degree in the course of a few weeks and altogether change the character of the water in which this multiplication takes place. Others again multiply in attachment to iron pipes and accelerate the formation of incrustations, necessitating the installation of new pipes or a thorough cleaning of the affected ones. In other ways also they show characteristics which make it incumbent to know at any rate the leading features in their life histories, and also the general principles which should guide all plans for the minimizing of their activities.

Besides the life histories already mentioned, the author points out in the six first chapters the importance of the organisms described to engineers. In addition, there is a chapter on Iron Bacteria in Relation to Water Reservoirs and Corrosion of Conduit Pipes in which slimy streamers, incrustation and tuberculation are discussed and a chapter on Treatment of Water Infected by Iron Bacteria. Still other chapters

deal with the artificial cultivation of iron bacteria, their physiology and their relation to rock formation.

Although the designedly practical portions of the book form only a small portion of the whole and are limited mostly to general principles yet they, combined with the description of the organisms, promise to be of considerable value, as they certainly are of much interest, to the studious and progressive water-works superintendent, engineer, chemist and biologist.

Centralized Government Purchasing

PRINCIPLES OF GOVERNMENT PURCHASING—By Arthur G. Thomas. New York and London: D. Appleton & Co. Cloth; 6 x 9 in.; pp. 273. $3.

THE COMING OF CENTRALIZED PURCHASING IN STATE GOVERNMENTS: Supplement to the National Municipal Review, Feb., 1920—By A. E. Buck, New York Bureau of Municipal Research. Philadelphia, Penn.: National Municipal League. Paper; 7 x 10 in.; pp. 18; 25c.

The inefficiency of public as compared with private business administration is perhaps nowhere more evident than in the purchase of government supplies. Progress in that field is shown by the appearance of Mr. Thomas' pioneer book on government purchasing, based in part upon actual practice. Thus, the author states that "he made a personal study of the purchasing systems of thirty or more large corporations and ten important cities." Reference is also made to the work of the General Supply Committee of the Federal Government. Little is said about central purchasing by states but the author has information showing that of 113 cities canvassed "64 have centralized their purchasing in greater or less degree."

The volume has two main parts, one on Basic Problems of Government Purchasing, and the other on Purchasing Methods. Specifications, bids and inspection are among the subjects treated in Part II, but the discussion is brief. Appendixes contain outlines of the purchasing systems of the General Electric Co. and the New York Central Railroad, Eastern Division. Other private purchasing systems and those of a few cities are outlined earlier in the book.

Without any intention of belittling the volume, it should be noted that it is written from the viewpoint of the investigator rather than that of the man actually engaged in purchasing, and that the viewpoint is still more remote from that of the department staffs that use the supplies bought. This is generally true of pioneer books, but the volume is nevertheless a valuable addition to the literature of government administration.

Since the publication of Mr. Thomas' book there has appeared the brief review by Mr. Buck of central purchasing in a dozen American states, noted at the head of this article. The governing statute of each of the states, purchasing methods and procedure, and operating results are summarized, and conclusions are drawn.

Ex-Mayor Hanson's Message to Americans

AMERICANISM VERSUS BOLSHEVISM—By Ole Hanson, Former Mayor of Seattle. Garden City, N. Y.: Doubleday, Page & Co. Cloth; 5¼ x 7¼ in.; pp. 299; frontispiece portrait of author; $1.75.

Not the least interesting part of this book is the portion that tells of the inception, occurrence and swift ending of the general strike at Seattle on Feb. 6, 1919. This strike, according to ex-Mayor Hanson and reports current at the time, was designed to start a revolution in America that would speedily put all industry in control of councils of soldiers, sailors and workmen. The credit for the swift suppression of the strike, which if successful would have set aside the duly constituted government of the city, was due to the prompt uncompromising action of Mr. Hanson, backed by the sturdy citizenship and patriotism of the mass of the people of Seattle. The larger part of the book deals with the broad subject indicated by its title. In it are set forth something of the history, aims and results of revolutionary labor movements in Europe and America—all designed to elucidate Bolshevism and I. W. W.-ism on the one hand and Americanism on the other. With some readers the book would be more effective if it were materially condensed, but perhaps the many repetitions of the same ideas, often with little essential verbal change, are justified in a book of popular appeal designed to combat Bolshevism.

An English Engineer on Road Building

MODERN ROADS—By H. Percy Boulnois, M.Inst.C.E., F. R. San. Inst., etc. Late City Engineer of Liverpool; Late Deputy Chief Engineering Inspector of the Local Government Board; Chairman of the Council of the Roads Improvement Association. London: Edward Arnold. Cloth; 6 x 9 in.; pp. 302; illustrated. 16 shillings; $5.75 in United States.

Mr. Boulnois prefaces his work with the assertion that he has "endeavored to deal with the subject of roads in as comprehensive a manner as possible, bearing in mind the constant improvements in methods of modern road construction that are now taking place." But he has done more than that. He has not only given details concerning the best practice in constructing roads of various types, as well as city paving, but he has paid particular attention to those questions which determine the economics of building one or another type of hard surfacing. He has cited some most interesting figures of highway traffic, and he indicates the practice among certain engineers in England of what types shall be selected for varying traffic. Minute are Mr. Boulnois' various specifications for the construction of waterbound macadam roads. His treatment of the subject of the construction of asphaltic types is thorough, and he includes definitions of, and specifications for, using numerous modern types of bituminous mixtures, many of which are unknown to American road builders. There is a chapter n "Waves and Corrugation" and a part of another chapter treats of "Slippery Streets." In discussing modern road construction the author gives both British and Continental experience. American practice is frequently mentioned. Appendixes gives resolutions adopted by the Conference of Road Users on Traffic Regulations and the traffic rules of the Royal Automobile Club.

Mr. Boulnois' volume is unique in that it contains neither cost data or reproductions of highway photographs. The former are excluded owing to the present fluctuation in material and labor costs, and the latter because "they are of little practical value." Although there are no halftone views of roads the volume contains a number of plates showing various construction plants. Four of these show the Teddington road-testing machine and one is an interesting view of the "Liverpool System of 'Hand' Concrete Mixing" in which, as here shown, there are five two-compartment mixing boxes, each double box supplied with water from a bucket-filled tank having two outlets and each box having a separate measuring box just back of it.

Although of primary importance to English road engineers and contractors, Mr. Boulnois' book has a broad appeal to American engineers as well.

Tests of Protection From Sand Blast Dust

Twenty pages of *Public Health Reports* for March 5, 1920 (Washington, D. C., Superintendent of Documents; 5c.) are devoted to a report on studies of "The Efficiency of Certain Devices Used for the Protection of Sand Blasters Against the Dust Hazard," by Prof. C.-E. A. Winslow, Yale School of Medicine, Leonard Greenburg and E. H. Reeves. The general problem and earlier studies are reviewed briefly before detailing and summarizing the studies forming the subject of this report, which has to do with a sand blast cabinet in an automobile factory. The installation tested proved to be satisfactory, in the opinion of the authors.

Pocket Specifications for City Work

To the loose-leaf specifications used by a number of cities the Engineering Department of the City of Rochester, N. Y., has added another feature, that of reducing the size to fit an ordinary 4¼ x 7½-in. note book. With this same idea of compactness blue prints are furnished from 6 x 8-in. photographic plates of tracings of standard paving sections, curb and gutter details, sewer trenches, manholes, frames and covers, sidewalk intersections, water pipe trenches, hydrant drips, gate valve boxes and covers, and monuments. These also are in loose-leaf form. The Department of Public Works of Seattle, Wash., although not using the loose-leaf form, has gone a step beyond—or remained a step behind Rochester, depending upon personal preference—in that standard plans and specifications are combined in a single 4¾ x 7½-in. book of 208 p., including an index.

PUBLICATIONS RECEIVED

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS: Transactions, Vol. XI, 1918—New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 430. $6.

BRITISH INDUSTRIAL RECONSTRUCTION AND COMMERCIAL POLICIES—By Fred W. Powell, Trade Commissioner. Washington, D. C.: Department of Commerce. Paper; 6 x 9 in.; pp. 88. 10c. from Superintendent of Documents.

CHANGES IN THE COST OF LIVING, July, 1914 to November, 1919—Boston, Mass.; National Industrial Board, 15 Beacon St. Paper; 6 x 9 in.; pp. 24. 75c.

CONGRES de L'HABITATION: Premier, 1919—Preface de M. Edouard Herriot, Depute, Maire de Lyon, Ancien Ministre—Lyon, France: Imprimerie Noirclerc & Fenetrier. Paper; 7 x 10 in.; pp. 284; illustrated.

Housing shortage is world wide and the problems of France are the problems of this country, accentuated by the terrible losses in the devastated region. This volume is the record of the French analogue of the recent housing conference held in Chicago, and is interesting only as it indicates how the French engineer and social worker is approaching the problem.

ENGINEERING PRACTICE: The J. E. Aldred Lectures at the Johns Hopkins University, 1918-19—Baltimore, Md.: The Johns Hopkins Press. Paper; 6 x 9 in.; pp. 235; illustrated. $1.

Contains nine lectures equally divided between civil, electrical and mining engineering, among which are: "The Human Element in the Machine Shop," by James Hartness; "Berthing and Repair Docks for Shipping," by Rear Admiral F. R. Harris, U. S. N., "The Duties of the Young Engineer on the Construction of a Hydro-Electric Plant," by H. S. Slocum, of Viele, Blackwell & Buck; and "Ore Docks on the Great Lakes," by John E. Greiner.

EXAMPLES IN HEAT AND HEAT ENGINES—By T. Peel, M. A., Fellow and Lecturer of Magdalene College, Cambridge University Demonstrator in Engineeering. New York: G. P. Putnam's Sons. London: Cambridge University Press. Paper; 5 x 8 in.; pp. 104; illustrated. $1.50.

Questions taken chiefly from papers set for the courses of lectures at the Cambridge Engineering Laboratory, and from the A and B papers of the Engineering Tripos.

FREE-FLOWING, TIGHT SEWAGE TANKS AS DEVELOPED IN NEW HAMPSHIRE: Special Bulletin of the State Board of Health—By Robert Fletcher, D. Sc., C. E., President of the State Board of Health. Concord, N. H.: The Board. Paper; 6 x 9 in.; pp. 19; illustrated.

Professor Fletcher's earlier story of what might be termed the "septic cesspool" is here brought up to date, with line cuts and text telling how to construct the tanks.

HOW TO MAKE AND USE GRAPHIC CHARTS—By Allan C. Haskell, B. S., Principal Assistant Engineer, Construction Service Co.; with an Introduction by Richard T. Dana, Consulting Engineer. New York: Codex Book Co., Inc. Cloth; 6 x 9 in.; pp. 539; illustrated. $6.

HYDRAULIC TURBINES: With a Chapter on Centrifugal Pumps—By R. L. Daugherty, A. B., M. E., Professor of Mechanical and Hydraulic Engineering, California Institute of Technology; Formerly Professor of Hydraulic Engineering, Rensselaer Polytechnic Institute. Third Edition, Revised, Enlarged and Reset. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 281; illustrated. $3.

HYDROMETRIC SURVEYS In the Provinces of Alberta and Saskatchewan, 1918—Prepared under the direction of F. H. Peters, D. L. S., M. E. I. C., Commission of Irrigation, by P. M. Sauder, D. L. S., M. E. I. C., Chief-Hydrometric Engineer; assisted by G. R. Elliott, D. L. S., A. M. E. I. C., and V. A. Newhall, A. M. E. I. C., Divisional Hydrometric Engineers—Ottawa, Can.: Department of the Interior. Paper; 7 x 10 in.; pp. 341.

IRRIGATION SURVEYS AND INSPECTIONS, Report, 1918-19—Ottawa, Can.: Department of the Interior. Paper; 7 x 10 in.; pp. 67; illustrated.

LANDSCAPE ARCHITECTURE: A Comprehensive Classification Scheme for Books, Plans, Photographs, Notes and Other Collected Material—By Henry Vincent Hubbard, Assistant Professor of Landscape Architecture at Harvard University, and Theodora Kimball, Librarian of the School of Landscape Architecture at Harvard University. Cambridge, Mass.: Harvard University Press. Paper; 7 x 10 in; pp. 131.

LOAD STRAIN—CAGE TEST OF 150-TON FLOATING CRANE FOR THE BUREAU OF YARDS AND DOCKS, U. S. NAVY DEPARTMENT—By Louis J. Larson, Assistant Engineer Physicist and Richard L. Templin, Assistant Engineer Physicist, Bureau of Standards. Washington, D. C.: Department of Commerce. Paper; 7 x 10 in.; pp. 34; illustrated. 10c. from Superintendent of Documents.

MECHANICAL WORLD YEAR BOOK, 1920—Manchester, England: Emmott & Co., Ltd. Cloth; 4 x 5 in.; pp. 317; illustrated. 2s.

A somewhat enlarged edition of this British annual. The preface calls attention to new matter on "water and hydraulic work" and on "heating and evaporating liquids," besides additions to material on compressed air and on screw threads.

THE MODEL T FORD CAR: Truck and Tractor Conversion Sets; Also Fordson Farm Tractor and F. A. Lighting and Starting System Construction, Operation and Repair—By Victor W. Page, M.S.A.E., Author of "The Modern Gasoline Automobile," etc. New York: The Norman W. Henley Publishing Co. Cloth; 5 x 7 in.; pp. 410; illustrated. $1.50.

THE QUEBEC BRIDGE Over the St. Lawrence River, Near the City of Quebec, On the Line of the Canadian National Railways—Ottawa, Ont.: Department of Railways and Canals—Cloth; 15 x 12 in. Vol. I—Substructure, Superstructure; Report of the Government Board of Engineers, 1908-18; pp. 259; illustrated. Vol. II—111 Plates to Accompany Vol. I. $6.

RETAINING WALLS: THEIR DESIGN AND CONSTRUCTION—By George Paaswell, C. E. New York and London: McGraw-Hill Book. Cloth; 6 x 9 in.; pp. 275; 9 plates and 133 figures in the text; $4.

SELLING YOUR SERVICES—By George Conover Pearson. New York: Jordan-Goodwin Corporation. Cloth; 5 x 8 in.; pp. 237. $2.

Appears to be an enlarged edition of a book with the same title, favorably noted in *Engineering News-Record*, June 21, 1917.

STRUCTURAL DRAFTING AND THE DESIGN OF DETAILS—By Carlton Thomas Bishop, C. E., Assistant Professor of Structural Engineering, Sheffield Scientific School of Yale University, etc. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 10 x 8 in.; pp. 352; illustrated. $5.50.

TELEPHONES: Census of Electrical Industries: 1917—Washington, D. C. Department of Commerce. Paper; 9 x 12 in.; pp. 52.

TOPOGRAPHIC MAPS AND SKETCH MAPPING—By J. K. Finch, C. E., A. M., Associate Professor of Civil Engineering and Resident Director of the Summer School of Surveying, Columbia University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 175; illustrated. $2.50.

TRANSPORTATION BY WATER, 1916—Washington, D. C.; Bureau of the Census. Cloth; 9 x 12 in.; pp. 230; 6 halftone plates and 29 figures in the text. 75c. from Superintendent of Documents.

Data for 1916, gathered in 1917, transmitted Oct. 9, 1919, for publication, and published in 1920. Divided into United States as a whole, Atlantic Coast and Gulf of Mexico, Pacific Coast, Great Lakes and St. Lawrence River, Mississippi River and Tributaries, Canals and other Inland Waters. Comparisons between 1906 and 1916 are made.

THE TURNPIKES OF NEW ENGLAND: Evolution of the Same Through England, Virginia, and Maryland—By Frederic J. Wood, M. Am. Soc. C. E., etc., Boston, Mass.: Marshall Jones Co. Cloth; 8 x 11 in.; pp. 461; illustrated. $10.

UNITED STATES BITUMINOUS COAL COMMISSION: Majority and Minority Reports to the President from Henry M. Robinson, Chairman, and John P. White and Rembrandt Peale, Commissioners, 1920—Washington, D. C.: The Commission. Paper; 6 x 9 in.; pp. 120.

WHAT IS THE EVENTUAL STREET CLEANING METHOD: A Review of the Methods that are now Being Used and Developed—Pointing Out the Advantages that Would Substantiate a Claim by Any System to the Possibility of Its Being Eventually Considered the Standard Method—By George C. Dodge. Flushing, N. Y.: Case, the Printer. Paper; 6 x 9 in.; pp. 56; illustrated. $1.

A readable, suggestive brief on the various methods of street cleaning that leads up to motor-driven combination machines (sprinklers with either frames or squeegees) and points to vacuum cleaners as the ideal end. The author states that he has been on the commercial side of street cleaning for the past five years.

LETTERS TO THE EDITOR

"Professional Plagiarism"

Sir—In your issue of April 1, p. 685, appears a letter from Samuel Baker in which he charges Professor Carlton T. Bishop with plagiarism in the preparation of a book entitled "Structural Drafting and the Design of Details." The specific charge is that Professor Bishop has reproduced diagrams for the "graphic solution of a right triangle" which appear in "Smoley's Tables," and an implied charge is that Professor Bishop "apparently drew a good deal of inspiration" for his book from Charles D. Conklin's book on "Structural Detailing and Elementary Design."

Mr. Bishop developed the diagrams in question and showed them to me some years before similar designs appeared in Mr. Smoley's book in 1914. I have just learned, moreover, that diagrams exactly the same in principle were used in the office of the McClintic-Marshall Company as early as 1905, at least nine years before they appeared in Mr. Smoley's book. Thus, it is evident that these diagrams were developed independently by Mr. Bishop, Mr. Smoley and others.

The insinuation that Mr. Bishop "drew a good deal of inspiration" from Mr. Conklin's book implies too much to be ignored, especially as I can disprove the charge from my own knowledge of the facts. Mr. Bishop's book was completely outlined and largely written several years before Mr. Conklin's excellent work appeared—I know, for I had read Mr. Bishop's manuscript. Both books are published by the same firm, and in view of the fact that Mr. Bishop's book had already been accepted and was so nearly completed, the manuscript of Mr. Conklin's book was submitted to Mr. Bishop and myself for criticism. It was only upon our assurance that the contents and methods of presentation were quite different in the two books that Mr. Conklin's book was accepted by the publishers.

Mr. Bishop's book is the natural fruit of long experience in practical work as well as in teaching. The war delayed the completion of the book, but for many years previous Mr. Bishop had devoted all of his spare time to the work. A charge of plagiarism is a poor return for the real service which Mr. Bishop has rendered the profession, and I am sure had Mr. Baker known the facts, as Mr. Bishop's colleagues know them, he would not have made the charge.

The serious aspect of this whole matter, aside from the injustice to Mr. Bishop, is that no member of our engineering profession should charge another member with stealing without first investigating the facts, and the facts in this case could have been easily ascertained. No engineering periodical, moreover, should publish such a charge without first submitting it to the person likely to be injured.

JOHN C. TRACY,
Professor of Civil Engineering, Yale University.
New Haven, Conn.

Railroad and Highway Location

Sir—In the several letters which have appeared lately pointing out the need of an "Economic Theory of Highway Location" there seems to be a general assumption that there is in existence a well defined "Economic Theory of Railway Location." This, however, is far from the truth. Many years ago when 30-ton cars and 90- and 100-ton locomotives were generally used; when electric traction was almost unknown, and when complications (such as the 8-hr. law, etc.) affecting the operation of modern transportation systems, unsuspected, Mr. Wellington developed his "theory." His work was pioneering and epoch making. As general theory, many of his ideas can be used today. but even *his* theories are not wholly applicable now, and the data to which he applied his theories are practically out of date.

Several engineers, acting independently, have worked out some modifications of parts of the theory to suit modern conditions. The American Railway Engineering Association has had a Committee on Economics of Railway Location, for a number of years. This committee, or individual members of it have done some good work, but it is all fragmentary, and it is probable that nothing really substantial and complete will be formulated until a fair size appropriation is made and full co-operation of the railroads is obtained, and a technical staff appointed to make the necessary experiments and obtain data on which to base a theory fitted to modern conditions. The problem is so complex today that no individual, even with the ability of a Wellington, could hope to work it out.

One of your recent correspondents made the statement that "railroad location, due to rigid conditions, is a science." I can hardly imagine either a science or an art with more variables or where individual judgment and experience count for more, except possibly highway location. The theoretically correct highway engineer will have to strike a nice balance between political exigency, local prejudice, vested interests, conditions under which state, and county funds, etc., can properly be applied to providing free roadbeds for foreign vehicles, as well as questions of gradients, curvature, first cost and cost of maintenance.

So long as we have recognized the fact that the public has a definite interest in the well being of the railroads and must pay in some form or other for their maintenance in first class condition, it will necessarily be but a comparatively short time before the people realize that there is a limit to the taxation which they can afford to impose on themselves as a community to provide routes for heavy motor trucks to traverse. All these questions open up vast vistas for profitable investigation, but it must necessarily be nation wide, and supported by ample funds to be of any real value.

F. LAVIS,
New York City. American International Corporation.

Tests Reveal Relative Values of Pneumatic and Solid Tires

Sir—I read with much interest the article on "Tests Reveal Relative Values of Pneumatic and Solid Tires," p. 668, in your issue of April 1. My particular object in reading it was to see whether I could obtain any information on impact for use in bridge designing. The article did not help me much in that respect, but I noticed that the equation used to compute the force with which the wheels struck the ground took no account of the height through which the truck dropped.

It was stated that "the energy exerted by a falling body is equal to the energy required to raise it to the height from which it fell," but the simple method of computing this energy by multiplying the weight by the height of fall was not used. In fact the method used was to apply the well known formula for kinetic energy, $WV^2/2g$, and then to use for the velocity v the vertical component of the horizontal speed of the truck due to the slope of the take-off, entirely neglecting the vertical component due to the acceleration of gravity. The formula given in the article

$$F = \frac{W\left(\frac{22\,S\,T}{15}\right)^2}{64.32\,D} + W$$

apparently attempts to give the vertical force with which the truck strikes the ground but it contains no quantity involving the height through which the truck falls, and therefore it would apparently strike the ground with a force depending wholly upon the angle which the take-off platform makes with the ground. The result would be the same whether the distance through which it fell were 1½ ft. (as in the experiments) or 1½ miles. If the truck ran off of a level platform it would, according to the formula, ($T=0$), strike the ground with a force only equal to its own weight. Obviously there is either some element involved here which is not given in the article, or else the formula given is in error.

It would appear that the average force with which the unsprung weight strikes the ground can be determined by multiplying it by its height of fall, (including the compression of the tire) and dividing by compression of tire.

The average force exerted by the sprung weight on the axle can be determined by multiplying this weight by its total fall (including the distance the spring compresses) and dividing by the distance which the spring compresses. As pointed out in the article, it may be incorrect to add these two to get the total force on the roadway as they occur in different, though somewhat overlapping, intervals of time.

Applying the above to the unsprung weights of trucks E8 (solid tire) and E17 (pneumatic tire) gives the following:

$$\text{E8} \quad \frac{1716 \times (1.5 + .083)}{.083} = \frac{1716 \times 1.583}{.083} = 32800 \text{ lb.}$$

$$\text{E17} \quad \frac{1754 \times (1.5 + .375)}{.375} = \frac{1754 \times 1.875}{.375} = 8770 \text{ lb.}$$

The figures given for the same cases in the article referred to are 14,336 and 4,624 lb. respectively, or about half what they apparently should be.

It is suggested that if the trucks had been run over bumps on to the platform of some type of recording scale the forces exerted on the roadway would have been quite closely given by the scale.

LEWIS E. MOORE,
Bridge and Signal Engineer, Massachusetts Department of Public Utilities, Boston.

The Menace of the "Man-Power Engineer"

Sir—On p. 517 of your issue of March 11 there is an article by Frances A. Kellor dealing with the question of training engineers for the purpose of handling men. There are two premises which I take to be erroneous: First, that the management of human beings can be reduced to an exact science; second, that the engineer is the only man who can solve the problem.

Nature's laws are fixed; human nature also is, in the aggregate, pretty much the same in all places and at all times. However, while nature's laws recognize no evolution and no environment, the systems used in handling men must vary according to the locality and to the type of men for which the system is designed.

There are two variables which will always control in the management of men and forever make it impossible to reduce management of men to an exact science, namely, the changing ideas of the men being handled and of the men doing the handling. What we are contented with in one locality will breed discontent in another. Consequently there can never be a "Science of Man Power" in the sense that there is a Science of Physics or a Science of Chemistry.

Of course, this does not mean that there are not certain fundamental principles which, in all cases, apply to the problem of management and direction of human beings. Neither does it preclude the necessity of determining what these fundamental principles are. But are we making progress when we condemn all present conscientious efforts which are being made to solve the problem, just because there still are things to be desired? If recreations, hospitals, lunch rooms, etc., tend to make contented employees—and employers—have we not accomplished a part of what really is to be desired, at least for the time being? If a man "interested in saving souls" can have a part in making contented employees, should we condemn his work and turn him out for a trained scientist whose theories do not permit of tampering with men's souls because such action will not fit in with his ideas of what is necessary during the eight-hour productive period?

And, Miss Kellor to the contrary, is not man power largely an individual plant problem? Of course there are fundamental principles which are applicable in all places, but will the time ever come when the same system can be applied in the steel mills of the East, as in the lumber mills of the Northwest, or in the cotton mills of the South?

Getting down to what is really more vital to the engineering profession, at least in so far as it reflects on the engineer's ability and good judgment, does the profession want to subscribe to the idea that the engineer is a superman, that he alone is qualified to handle men? The writer is an engineer and hence more or less prejudiced in favor of the profession, but he holds that statements such as contained in the article under discussion do the profession a lot of damage, especially the younger members thereof.

There has been a very pronounced tendency in past years to give young engineers, especially college graduates, the idea that the engineer belongs to the elect, thereby hampering him in his business until such time as he realizes that this idea is erroneous.

So it will be with the "man-power engineer." If he thinks a college education along the lines of management of men will qualify him to handle men to the exclusion of those who have no theoretical ideas, except what they have gained by long contact with human beings, he is due for a very forcible awakening. Are we not flattering ourselves in a ludicrous fashion when we admit we "will be called upon to handle man power and to settle financial questions for which we have little preliminary training or basic judgment?" There is undoubtedly a growing demand for men with qualifications for handling man power on a large scale; but will men be employed simply because they call themselves engineers?

The only reason why engineers are more successful than others in handling certain problems of management is because they are trained to go deeply into matters, to seek facts and to analyze conditions. If a man possesses an analytical mind, is he to be denied the privilege of using his abilities in certain fields simply because he does not have an engineering education or degree?

And will the engineering colleges be successful in turning out men qualified to direct and manage men? Would it not be better to base our hopes on developing managers of men, such as Miss Kellor has in mind, as we develop executives, by the process of hard knocks and elimination? Certain fundamental principles can be taught in the colleges to very good advantage, but a college degree alone will never make a manager. We, as engineers, should consider the field of management a very promising one and should be governed by no sense of mock modesty in maintaining that engineers, as a class, are best qualified for this line of work. However, we should show charity toward men outside the profession, realizing that results, and not men or methods, is the final test.

May a guiding Providence preserve us from the man-power engineer.

D. E. GELWIX,
Division Engineer, St. Louis & San Francisco R.R.
Springfield, Mo.

Dyckman Street Screening Results

Sir—On p. 526 of your journal of March 11, attention is called to a typographical error in the article on "Operating Results of Dyckman Street Sewage Screening Plant," published Jan. 20, 1920, p. 171. In Table I the following errors also require correction:

June 10, 2:15 a.m. to 6:15 a.m.

Screenings removed by $\frac{3}{4}$-in. screen should be 37.0 instead of 3.7 ppm.

Removal of suspended matter should be 92.5 instead of 9.25 per cent.

Removal of settleable solids should be 92.5 instead of 9.25 per cent.

Summary of results of 24-hr. test, Screen No. 2:

Removal of suspended matter should be 16.4 instead of 16.6 per cent.

Removal of settleable solids should be 25.6 instead of 19.4 per cent.

The abnormally high removal noted in one test between 2:15 and 6:15 a.m. of 92.5 per cent was probably due to absence of domestic wastes with a preponderance of ground water at that time and should not be regarded as significant in judging operating efficiency. It may be of interest to add that the weighted average removal of suspended matter when operating on day sewage was computed at 20.6 per cent with $\frac{3}{4}$-in. slots and 14.6 per cent with $\frac{1}{8}$-in. slots.

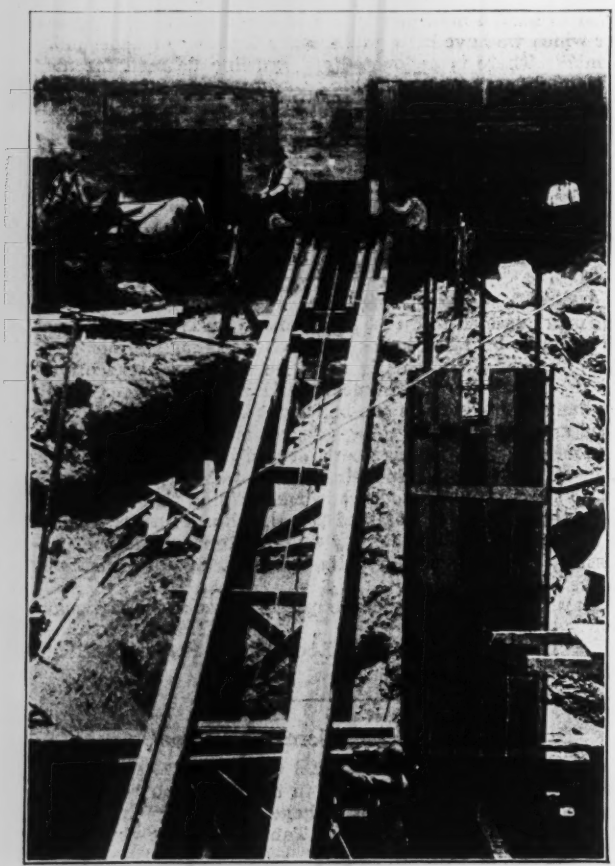
KENNETH ALLEN,
Sanitary Engineer, Board of Estimate and Apportionment.
New York City.

HINTS FOR THE CONTRACTOR

Timber Track Takes Spoil from Basement

By C. W. Geiger
San Francisco, Cal.

THE job-built incline elevator shown by the illustration met a construction emergency successfully enough to deserve record. After the concrete foundations had been completed for one of the six-story buildings of the Los Angeles Warehouse, one of the tenants decided



INCLINE HOIST LOADS DUMP WAGONS

that it was necessary to install a boiler room in the building which he was to occupy. As a result it was necessary to remove a number of the reinforced-concrete column foundations. Air drills were used in cutting holes in the concrete foundations, which were broken up by dynamite.

It was also necessary to extend the foundation several feet lower, thereby necessitating additional excavation. In order to elevate this material an incline track was built from the point of excavation to the street, and a dump box was equipped with wheels for running up and down on the incline. The hoist that was used in operating the concrete elevator was connected to the dump box, which, on being raised to the top of the incline, automatically dumped the excavated material in dump bottom wagons. A tail line enabled the box to be pulled back by hand.

Chutes to Mixer Serve as Measuring Boxes

IN the concrete mixing plant used on the construction of the Gibraltar dam near Santa Barbara, Cal., the chutes leading from sand and gravel bins into the mixer hopper were used as measuring boxes. The chutes were of rectangular cross-section with covers made of light wood strips placed longitudinally and held together by cross pieces. These covers were hinged at the upper, or bin end, so that when the material from the bins entered a chute and backed up behind the closed gate at the bottom, the chute cover would be forced upward until stopped by pegs placed in the sides for that purpose. The cover prevented overflowing and when the chute was full the flow from the bunker was automatically stopped by the choked gate opening. The bunker gate was provided with a knife edge so it could be closed when the gateway was choked in this manner.

When the proportions of the mix had to be varied the pegs in the chute sides were moved to holes above or below according to whether greater or less quantities were required. A full chute constituted just a charge for the mixer. Thus the single action of opening the doors at the chute bottom dropped the right charges of sand and gravel into the mixer hopper. W. A. Kraner, of San Francisco, is the contractor to be credited with this device.

Military Pile Driving With Motor Truck

DURING the military operations on the Salonika front, according to *The Engineer*, it was necessary to construct a bridge across the Selimb River. The work required the driving of forty-eight piles about 40-ft. long and 12-in. square to a depth of 24-ft. in gravel, clay, and quicksand. A pile-driver with 30-ft. leads and a 1,200-lb. hammer was employed and a 4-ton motor truck used to raise the weight. The truck was set up on the bank, the left-hand rear wheel was jacked up and blocked 10-in. from the ground, and the other three wheels were snubbed and staked to the ground. The lead rope was given a turn on the brake drum inside the wheel, one man operating the loose end. The distribution of labor was as follows: One motor driver, one signalman, one on the lead rope, three on the pile-driver, and two sharpening and putting on pile rings. Work was continuous in three 8-hour shifts, and the bridge was completed for traffic in 12 days.

Belt Conveyor Assists Excavation

A portable belt conveyor to remove excavated material and load it into wagons was used by the Lincoln Gas & Electric Co. in the excavation for three 110,000-gal. oil storage reservoirs at Lincoln, Neb. The belt travels on a steel truss boom pivoted to a wagon bed which carries a gasoline engine, the ends of the boom being guyed from a gallows frame seated on the wagon bed. With the machine placed on top of the bank the boom is inclined with one end in the pit, where men shovel the material onto the belt, while the other end is high enough for wagons to drive under it to receive the material. The machine was shifted around the pit as excavation progressed.

NEWS OF THE WEEK

New York, April 15, 1920

Truck Weight Limit Reduced To Save Soft Roads

Owing to the bad condition of some of the Connecticut state highways a temporary order was put in effect April 8 limiting the amount of load allowed on the highways to 10 tons. In some places near Hartford the "blowing up" of short stretches has resulted in the roads being reduced to quagmires under the heavy truck traffic. C. J. Bennett, State Highway Commissioner, believes the condition of the roads to be generally worse now than at any time in his experience. As soon as possible the statute provision of 12½ tons, truck and load, will prevail again.

Commissioner Bennett is keeping close watch on the truck operators and when a truck is suspected of loading beyond the statute provision it is weighed. Several arrests have recently been made and on April 5 a driver from a neighboring state was fined $150 for driving while intoxicated and for carrying a load well above 12½ tons.

In the opinion of W. L. Ulrich, State Superintendent of Repair, the raising of the water level in the soil through the heavy rains of last fall is responsible for the condition of the roads.

Expel Union Draftsman From Pittsburgh Chapter, A. A. E.

At its regular business meeting the Pittsburgh Chapter of the American Association of Engineers, by an overwhelming majority, voted to expel one of its members because of his connection with the Draftsman's Union.

The attitude taken was that while the Pittsburgh Chapter of the American Association of Engineers had no quarrel with the labor unions, as such, its members could not possibly live up to the ideals of the association, which believes in co-operation between labor and employer, and at the same time uphold the ideas of trade unionism.

Advisory Council for Map Board Being Formed

An Advisory Council to function with the U. S. Board of Surveys and Maps is being formed. A number of organizations such as the American Society of Civil Engineers, the American Association of State Highway Officials, etc., have been asked to appoint a representative on the Advisory Council. In addition five commercial map-making houses have been asked to join in designating one joint representative.

Advises Universal Metering

Water meters for all consumers in Halifax, N. S., have been recommended.

Vote on Am. Soc. C. E. Questionnaire

At noon, April 14, the day on which the polls closed, there had been received at the office of the Secretary of the American Society of Civil Engineers 3,871 votes on the Questionnaire covering proposed changes in the Society's internal and external relations, as discussed in the report of the Committee on Development.

Harding Retired With Rank of Brigadier General

Colonel Chester Harding, Corps of Engineers, U. S. Army, has been retired from active service with the

BRIGADIER GENERAL CHESTER HARDING, RETIRED

rank of brigadier general. He will continue as Governor at Panama.

General Harding was born in Mississippi, Dec. 31, 1866. He was appointed to the Military Academy from Alabama in 1885. He was graduated in 1889 and has served throughout his military career with the Corps of Engineers. He was graduated from the Engineer School of Application in 1892.

Bid Date for Fine Sewage Screens at Milwaukee Advanced

To afford bidders for fine sewage screens more time to prepare complete and comprehensive proposals the Sewerage Commission of Milwaukee, Wis., has extended the time for submitting bids from April 8 to April 22. The specifications for these screens were published nearly in full in *Engineering News-Record*, March 11, 1920, p. 511.

New York Section, Am. Soc. C. E., Approves Licensing

By a vote of 36 to 23 the newly-formed New York section of the American Society of Civil Engineers, March 31, approved an engineers' license bill pending in the New York State Legislature after full discussion of Senate Bill 1248.

C. M. Holland explained that the bill was based on that recommended by Engineering Council with minor modifications mainly to meet New York statutory requirements. While not ideal, in his opinion, he favored its support because he felt that it would set minimum standards for engineers and give the profession a standing.

John A. Bensel, reporting on the progress of the bill, indicated that its passage seemed assured. Representatives of the Albany Society of Engineers and the New York Chapter of the American Association of Engineers, he said, had in conference with the judiciary committee, stricken out a clause which restricted the practice to citizens and changed the date when the bill would go into effect to two years from date of passage. As the reciprocity clause now reads, engineers qualified to practice in their home states or countries would be permitted to practice in New York State.

Allen Hazen asserted that the bill was the most innocent of any yet proposed, but he was decidedly opposed to the principle of licensing. He felt that there would be a retaliation against American engineers who attempted to obtain foreign engagements if restrictions were made at home. F. Lavis expressed doubt as to this point, since most foreign countries already have similar laws, and the interests which employ the engineer simply consider arrangements for the engagement of registered or licensed engineers as one more necessary formality.

President Davis a Progressive

An address urging full acceptance of the Joint Conference report was made by A. P. Davis, president of the parent society, and was enthusiastically received. He said the society "would not be embarking upon uncharted seas", for it had the experience of Engineering Council as a guide. The latter had done remarkably good work, in his opinion, considering the restrictions under which it was placed. To the conservative element in the society he attributed the failure to live up to its technical obligations. Had the American Society of Civil Engineers been more progressive, said Mr. Davis, the American Society of Testing Material would never have been formed, nor the American Railway Engineering Association. Work done in these organiza-

tions and many others is performed in large measure by Am. Soc. C. E. members. It could have been carried out better, and would have had more standing, but, said Mr. Davis, "we stayed in our shell and did nothing." The same conservative element, he asserted, is now opposing another proposed expansion of the society's activities.

A nominating committee, consisting of S. N. Castle, E. J. Mehren, F. Lavis, D. L. Turner and C. M. Holland, was chosen by ballot to report a ticket of officers of the section two weeks in advance of the annual meeting, May 12.

New Headhouse of St. Paul Union Depot Opened

The new headhouse of the St. Paul Union Depot Company was opened to passenger traffic April 5, completing the first construction stage of the new terminal project, as outlined in *Engineering News-Record*, June 20, 1918, p. 1184. Work on this building started in August, 1917, foundation work being practically completed when the railways were taken over by the Administration Jan. 1, 1918. After a long period of negotiation, the building of the terminal was placed on the priority list, and work was resumed Aug. 13, 1918.

Work is now in progress on the second construction stage, involving a structure to carry six new stub tracks and the erection of a portion of the permanent waiting room above them.

St. Paul has long been in need of adequate terminal facilities for passenger traffic, as the city is the transfer for all traffic—passenger, mail and express—for the Northwest. The station is used by nine roads, four of which extend to the Pacific Coast.

W. C. Armstrong is chief engineer in charge of the project. Morris, Shepard & Dougherty and George J. Grant Construction Company, copartners, are the general contractors. Charles S. Frost, Chicago, is the architect.

Commission To Study Mail Tunnel Plan in Large Cities

As a result of the agreement of the conferees on the postoffice appropriation bill, a commission is to be appointed which will study among other things the advisability of establishing a system of tunnels for the handling of mail matter in large cities. These tunnels have been suggested as a substitute for pneumatic tubes.

The commission is to consist of the chairman and four members of the Committee on Postoffices and Post Roads of the Senate, and the chairman and four members of the corresponding committee of the House, and a postal expert appointed by the Postmaster General. The Commission in turn is to appoint an advisory council of seven to be composed of those having special knowledge of the problem.

U. S. Chamber of Commerce to Hold Annual Meeting

"Increased production" is announced as the keynote of the eighth annual meeting of the Chamber of Commerce of the United States, to be held at Atlantic City, N. J., April 26 to 29, inclusive. The program provides for both general sessions and group meetings. In the fields served by readers of *Engineering News-Record* the following addresses are scheduled: "Port and Terminal Facilities," by B. F. Cresson, consulting engineer, New York and New Jersey Port and Harbors Development Commission; "Highways," by George M. Graham, general manager, Pierce-Arrow Co.; "The Country's Highway Program," by Thomas H. McDonald, director, U. S. Bureau of Public Roads; Roy D. Chapin, Hudson Motor Car Co.; W. A. Alsdorf, Ohio Good Roads Federation, and A. G. Batchelder, American Automobile Association.

"The Regulation of Highway Transportation" will be the subject of an address by J. F. Witt, Nagle, Witt, Rollins Engineering Co.

The group meeting on Industrial Production will have as its chairman Charles F. Lang, president, Lakewood Engineering Co.

James H. McGraw, president, McGraw-Hill Co., will speak on "The Function of the Business Press in Relation to Production."

Western Society Will Have Lunch Meetings and Talks

Monthly luncheon meetings have been arranged by the Western Society of Engineers, the first being held on April 2, with an address by Samuel Insull on the engineer's influence in public utilities.

Ohio Technical Societies Endorse Joint Conference Report

At a meeting in Columbus on March 30 the Association of Ohio Technical Societies instructed the secretary to advise the secretary of Engineering Council that "the sense of the meeting favored the report of the Joint Conference Committee of the Founder societies, and that the Association of Ohio Technical Societies desired to cooperate with the Founder societies in any manner that might be advantageous."

The following officers were elected: President, C. L. Rood, Toledo; vice-president, Monroe Warner, Cleveland; secretary-treasurer, G. Gale Dixon, Akron.

Membership in the association is held by the following Engineering Societies throughout the state: Cleveland Engineering Society; Cleveland Chapter of the A. A. E.; Cincinnati Chapter of the A. A. E.; Ohio Engineering Society; Engineers' Club of Columbus; Engineering Society of Akron; Toledo Chapter of the A. A. E.; N. W. Ohio Surveyors' Association.

Urge Membership in International Roads Congress

At a recent conference of the executive committee of the the American Association of State Highway officials, the recommendation was made that the United States accept the invitation of foreign countries to join the permanent International Roads Congress. The invitation was transmitted through the Consul General at Paris to the Secretary of Agriculture. Inasmuch as the roads congress constitutes an international tribunal for bringing together the best experience and results in highway construction and administration, the joining in by the United States has been strongly urged by Thomas H. MacDonald, chief of the Bureau of Public Roads, a member of the executive committee of the American Association of State Highway Officials, and who advised Secretary Meredith of that committee's recommendation. The suggestion has also been made that an invitation be extended to the road congress to hold its next annual session in the United States.

To Enlarge Advisory Committee

Secretary Meredith notified the highway officials that he would enlarge the advisory committee of state highway officials, which consults with the department on Federal road building policies, to include the entire executive committee of twelve members. This step has been taken so that the committee can better represent all parts of the United States, and make it more possible to work out a classification of roads for the entire country, thereby providing a basis for a more orderly national program of road building. The officials who attended the meeting were: Paul D. Sargent, chief engineer, Maine State Highway Commission; George P. Coleman, chairman, executive committee, Virginia State Highway Commissioner; W. G. Thompson, State Highway Engineer, New Jersey; George E. Johnson, State Highway Engineer, Nebraska; W. D. Uhler, State Highway Engineer, Pennsylvania; S. E. Bradt, Superintendent of Highways, Illinois; and Thomas H. MacDonald, chief of the Bureau of Public Roads, Washington, D. C.

Engineering Section of Safety Council To Meet April 27

The engineering section of the National Safety Council has called a conference of all persons interested in engineering and accident prevention, to be held at the Engineering Societies Building, New York City, April 27.

The morning session will take up the relationship of safety and engineering efficiency and the question of safety education in technical schools. The afternoon session will be devoted to safety standards: First, the present movement for uniform standards; second, the National Safety Council's part in this movement.

To Form Welfare Association in Canada

A new association, named the "Institute of Professional Civil Servants," is being formed in Canada to promote the welfare of its members, to maintain high professional standards and to enhance the usefulness of the service to the public.

Membership will be open to those officers of the public service of Canada who are engaged in (a) engineering, (b) technological or (c) scientific work, or the direction of administration of such work.

No Open Opposition to Public Works Bill, Report States

Marshall O. Leighton, chairman of the National Public Works Department Association, has issued the following statement regarding the status of the campaign for which the association was formed:

"No open opposition of any consequence has yet developed. We have been agreeably surprised to find approval in many places where we expected opposition. Outside of Congress, the movement has been endorsed by such men as Herbert C. Hoover, General Leonard Wood, Governor Frank O. Lowden, General George W. Goethals, W. Murray Crane and others. Each day brings news concerning the approval of some important person.

"The members of Congress are friendly to the Jones-Reavis Bill, but our difficulties lie in securing concerted action thereon. This is due to two causes: First, the lack of strong and effective effort from "back home"; second, the fatigue of Congress. The latter difficulty applies to all legislative measures. The members are so distracted by the consequences of war and the political conditions that it is difficult for them to concentrate on anything. It is practically impossible to keep a quorum on the floor of either House even to act on the appropriation bills necessary for the conduct of Government work. Committee chairmen find it difficult to secure committee attendance and hearings are attended by merely a handful of legislators. Much important legislation of an urgent nature is being held up by this condition, and, from an impartial survey of the situation, it appears certain that the public works bill is making as much or more real progress than any other legislation now being considered. Even the budget legislation, which was pledged in party platforms three years ago, has been hung up in Senate Committee for three months.

"The members of both Houses of Congress are anxiously looking forward to a vacation which they richly deserve. We hope that our bill will be brought out of committee of both Houses and placed on the calendar prior to adjournment, but in order to make sure of this, renewed efforts should now be made to show the members of both Houses of Congress that their people back home demand immediate action that will secure organized economy in our public works."

On April 6 the contributions received in support of the association's campaign totalled $14,750.

Dr. George Otis Smith Receives Geographical Society Medal

The American Geographical Society on April 6 awarded the Charles P. Daly gold medal to George Otis Smith, director, U. S. Geological Survey. The medal bears this inscription: "To George Otis Smith, Director of the United States Geological Survey. He

GEORGE OTIS SMITH

helped disclose and develop the natural resources of his country, adapting them to its service in peace and war."

President Greenough of the Society in making the presentation spoke of the patriotic and vital part taken by the Geological Survey in the prosecution of the war. He mentioned that 477 members of the Survey had been in the military service. While asserting that the Director of the Survey is entitled to first place in the allocation of honor for the organization's recent achievements in the application of geographic science to the Nation's needs, President Greenough made it plain that the Daly medal is also a public recognition of the work done by Lieutenant Colonels Brooks, Marshall, Birdseye and Glen Smith; Major Bagley, Dr. Umpleby and Dr. Bastin, in the organization of departments of work of special importance to the Nation, at home and in France, in addition to Majors L. L. Lee and J. H. Wheat, Captain A. T. Fowler and Lieutenant Mudd, and many others.

The Daly medal has been awarded to the Arctic explorers Perry, Amundsen and Stefansson and to other geographers, including two members of the United States Geological Survey, G. K. Gilbert and Alfred H. Brooks.

U. S. Chamber of Commerce Issues Public Works Questionnaire

The question of whether or not the Federal Government should establish a Department of Public Works was submitted April 12 for a referendum vote to the 1,305 member organizations of the United States Chamber of Commerce. The result of the referendum will determine the National Chamber's attitude on this quastion when it comes up for Congressional action.

The committee appointed by the National Chamber to make a study of this matter drew up the following questions for submission:

1. Shall there be established by the National Government a Department of Public Works?

2. Shall such department be established by a suitable modification of the existing Department of the Interior excluding therefrom the non-related bureaus or offices and by the change of name of the Department of the Interior to the Department of Public Works?

3. Shall such department be established by the creation of an entirely new department?

The desirability of a Federal Department of Public Works was suggested by Engineering Council, an organization member of the National Chamber. Engineering Council believes there is an urgent need in the National Government for such a department to carry on the work of an engineering and construction character.

Engineering Council has gone on record as favoring the adoption of the Jones-Reavis Bill, now pending in Congress, providing that the name of the executive department at present designated as "Department of Interior" be changed to the name of "Department of Public Works" and that the head thereof shall continue to be a member of the Cabinet under the official designation "Secretary of Public Works." This bill would transfer much of the work now transacted by bureaus under the Department of Interior.

The committee appointed by the Chamber in making its recommendation did not pass upon the merits of the proposals embodied in the Jones-Reavis Bill. Instead, it submitted the three propositions for a referendum vote, one of which calls for an independent Department of Public Works.

Charles Nagel, formerly Secretary of Commerce and Labor, and honorary vice-president of the National Chamber, was chairman of the committee, the other members of which were: Samuel B. Botsford, Buffalo; J. Parke Channing, New York; L. S. Gillette, Minneapolis; Ira N. Hollis, Worcester, Mass.; Frederick H. Newell, Urbana, Ill.; William C. Redfield, New York City, formerly Secretary of the Department of Commerce; Frank A. Seiberling, Akron, Ohio; F. Harper Sibley, Rochester, N. Y.; M. C. Tuttle, Boston; William F. Willoughby, Wash.

Major E. A. Kingsley Receives French Decoration

In recognition of his work as officer in charge of road construction and maintenance in the Intermediate Section, East, of the A. E. F., with headquarters at Nevers, France, Major E. A. Kingsley, Engineers, consulting engineer and formerly city engineer of Little Rock, Ark., has received from the French government, through the adjutant general of the U. S. Army, the "Merite Agricole." The decoration was awarded on recommendation of Colonel Mahieu, of the French road service, with whom Major Kingsley was associated in his duties abroad.

McClintic-Marshall Claim Still Fails To Receive Approval

Another effort to secure action on the bill to relieve the McClintic-Marshall Company failed in the Senate on April 6, but it is believed that the question has been threshed out sufficiently to permit the passage of the measure the next time it is reached on the calendar. The claim grows out of work done by the company in Panama. The claim originally was for nearly $2,000,000, but only $700,000 of the claim was approved. The claim was investigated by special commission headed by General Rosseau.

Detroit Votes to Build Municipal Street Railway System

Bonds to the amount of $15,000,000 for a municipally owned railway system were approved by a popular vote of 89,285 to 51,093 at an election held in Detroit, Mich., April 6. The affirmative vote was about 64 per cent of the total against a required 60 per cent to carry the bond issue. The bonds will be used to construct and equip 101 miles of track and to take over 55.5 miles of lines now operated by the Detroit United Rys., the franchise for which has expired. These lines will not be taken over until the city has constructed its proposed line. The system thus built and acquired by the city will be run in opposition with the remaining lines of the Detroit United Rys. Construction of the city line was begun the next day after the favorable vote.

A charter amendment adopted in 1913 provided for a street railway commission which was to acquire a railway. In November, 1915, and again in 1919 the people voted against buying the property of the Detroit United Rys. The first defeat was attributed to the fact that no price had been fixed, the plan being to have the price determined by the judges of the Wayne County Circuit Court. In the 1919 election the defeat of the proposed purchase was attributed to the fact that the price agreed upon between the city and the owners of the street railways was considered by the people to be excessive.

Small Slides Stop Panama Traffic

There was a renewal of slides in Gallard Cut on the Panama Canal during the end of March. Movement of the banks is to be expected there until equilibrium is reached and dredges are kept in attendance and work continually to keep the canal open. The recent stoppage had some prominence because it occurred just prior to the passage through the canal of the British warship carrying the Prince of Wales, but was not of particular importance.

Handling Machinery Manufacturers Elect Officers

At the meeting of the directors of the Material Handling Machinery Manufacturers' Association, April 6, the following officers were elected for the coming year: President, Charles F. Lang, president Lakewood Engineering Co., Cleveland; vice-president, Rumsey W. Scott, Otis Elevator Co., New York; treasurer, Lucian C. Brown, Elwell Parker Electric Co., New York, and secretary and manager, Zenas W. Carter, New York.

Argentina's Building Program

There is a large field for the sale of American construction materials in Argentina, according to a report just made public by the Bureau of Foreign and Domestic Commerce, Department of Commerce, which points out that the investment of American capital in Argentine enterprises is an important factor in securing contracts.

Buenos Aires is in great need of first-class office buildings. Several departments of the government are being crowded out of their old quarters for lack of space and modern hotels and apartment houses of the American type are required. Notices appear in the newspapers of the capital from time to time inviting bids on various public construction enterprises. The time-limit for these is usually short, but if American firms were represented in Buenos Aires they could secure many such contracts.

The National Council of Education has adopted a large building program for public schools. The plans to be completed in the next few years call for an expenditure of about $8,500,000. The needs of various cities in the Province of Buenos Aires will call for the installation of sewerage and water systems costing $2,300,000.

The various provinces of Argentina have building programs independent of those of the central government, says the report, but also receive federal aid in the execution of many public works. Definite projects in which the central government plans to aid the provincial governments in the immediate future call for an expenditure of $10,000,000 for sewerage and water systems alone.

The report is signed by Trade Commissioner W. W. Ewing.

Convention Plans of A. A. E.

Chapter representation at the sixth annual convention of the American Association of Engineers, to be held in St. Louis, Mo., May 10 and 11, will be in proportion to chapter membership. One chapter is entitled to one delegate or more, not to exceed one for each one hundred members. Each delegate is entitled to cast a number of votes equal to the number of certified and junior members in good standing in the chapter which he represents, but not to exceed five hundred in all.

One of the subjects to be discussed is "The Reorganization of A. A. E. on a Business Basis." The suggestion has been made by W. W. K. Sparrow, assistant chief engineer of the Milwaukee, that the association employ a high-salaried paid president. On the evening of the first day of the convention there will be held seven group meetings for various groups of engineers. Among the subjects to be considered are:

- Getting Salary Schedules for Public Service Engineers Into Budgets.
- What Part Shall A. A. E. Take in the Presidential Campaign?
- Making a Chapter a Force in a Community.
- The Federal Department of A. A. E.
- Opportunities for the Engineer in Each of the Various Branches of the Profession.
- Co-ordinating A. A. E. Activities in the State.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

TWELFTH NATIONAL CONFERENCE ON CITY PLANNING, 6o State St., Boston; Cincinnati, April 19-22.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston; May 4-6; Chicago.

AMERICAN ASSOCIATION OF ENGINEERS; 63 E. Adams St., Chicago; May 10, 11, St. Louis, Mo.

AMERICAN WATER WORKS ASSOCIATION, New York City; Montreal, June 21-26.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Asbury Park, N. J., June 22-25

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Aug. 30-Sept. 3.

The Association of Members, Am. Soc. C. E., San Diego, Cal., has elected for the coming year the following officers: President, George Cromwell; vice-president, Fred J. Grumm; secretary-treasurer, Rudolph C. Wueste.

The National Lumber Manufacturers' Association will hold its annual meeting April 20-22, in Chicago, in conjunction with the American Lumber Congress. Most of the papers scheduled relate to business, economics or politics.

The Engineers Club of Minneapolis, at a meeting, March 15, endorsed the principle of a law for licensing and registering engineers for Minnesota and advocated the introduction of a bill at the next session of the legislature. The matter was referred to the Minnesota Joint Engineering Board, with the recommendation for immediate action.

The "4 State Section," American Water Works Association, will hold a meeting at the Bellevue-Stratford Hotel, Philadelphia, Friday noon, April 16, at which time the Mayor of Philadelphia will outline the needs of that city in connection with its increased water supply.

PERSONAL NOTES

JOHN B. OTTO has resigned as city engineer of Williamsport, Pa. He was city engineer in 1876 and was again elected in 1909.

N. L. REEVE, formerly with the U. S. Reclamation Service, and more recently at Hog Island, has entered the hydraulic division of the Boston office of Stone & Webster.

W. E. HERRING, for many years connected with the U. S. Forest Service, and later with the Puget Sound Traction, Light & Power Co., has joined the hydraulic division of the Boston office of Stone & Webster.

AUGUST E. CHRISTHILF has been appointed chief engineer of the Annex Improvement Commission of Baltimore, succeeding J. Morris McCummings.

C. E. MILLER has been appointed chief engineer of the Belzoni Drainage District, Belzoni, Miss.

PHILIP L. SITEMAN has resigned from C. E. Smith & Co., consulting engineers, St. Louis, to become associated with D. G. Cooper, of Paxton, Ill. The new firm, known as Siteman & Cooper, civil engineers, will engage in general engineering practice.

HART CUMMIN, formerly sales engineer, Platt Iron Works Co., Dayton, Ohio, has become associated with Gaylord C. Cummin, New York City, in the practice of consulting municipal engineering.

WILLIS WHITED, for the past eight years bridge engineer, Pennsylvania State Highway Department, has been appointed consulting engineer to the department. Prior to joining the highway department, he was for 12 years bridge engineer of Pittsburgh.

STACY S. RUMPELTIN has been appointed village engineer, and JOHN A. GILES, of Binghamton, consulting engineer, of Johnson City, N. Y.

F. W. CROCKER, formerly traveling inspector for the U. S. Shipping Board, Emergency Fleet Corporation, Houston, Tex., has been appointed engineer of the Kansas City (Mo.) Bridge Co.

V. G. YOUNGHUSBAND, who has superintended the work on the new Parliament Buildings at Ottawa, has left the Peter Lyall Construction Co. to enter the employ of the Foundation Construction Co., Montreal.

H. C. CULVERHOUSE, formerly assistant highway engineer of Jefferson County, Ala., has been appointed assistant engineer of the Alabama State Highway Department, succeeding A. L. Smith, who has been made division engineer.

R. J. LEWIS has been appointed city engineer of Fort Madison, Iowa, succeeding H. R. LeSeur, resigned.

MAJOR CARL H. REEVES has been appointed superintendent of the Department of Public Utilities of Seattle, succeeding Thomas F. Murphine, resigned.

E. A. MORITZ, office engineer, U. S. Reclamation Service, Denver, Colo., has been appointed project manager of the Flathead Project, with headquarters at St. Ignatius, Mont.

ALLEN R. BOUDINOT, recently building inspector, Ordnance Department, Rock Island (Ill.) Arsenal, has become assistant engineer to E. E. Mashburn, consulting engineer, Cotton Plant, Ark. Mr. Boudinot was at one time city engineer of Davenport, Iowa.

PAUL B. SUTTON has been appointed city engineer of Watertown, N. Y.

MAJOR WILDURR WILLING, U. S. district engineer, at St. Louis, and secretary of the Mississippi River Commission, has been transferred to Boston, where he will be district engineer in charge of river, harbor and fortifications.

JOHN H. LEWIS, for 14 years state engineer of Oregon, and R. R. CLARK, formerly with the state highway department and more recently engaged in contracting and municipal engineering work at Portland, have organized the firm of Lewis & Clark, with offices in Portland. The new firm is prepared to act as consulting and managing engineers on irrigation, drainage, water power and municipal work, as well as the construction of bridges, grain elevators, docks and similar structures of steel and concrete.

E. J. BUEGLER, formerly consulting engineer of Westinghouse, Church, Kerr Co., has been elected vice-president of the Foundation Co. in charge of engineering.

J. L. HAUGH, formerly engineering assistant to the regional director of the Northwestern region, U. S. Railroad Administration, has been appointed assistant to the president of the Union Pacific, with headquarters at Omaha.

MAJOR ALBERT K. B. LYMAN, recently instructor in engineering at Camp Humphreys, Va., succeeds Major Wildurr Willing as U. S. district engineer at St. Louis.

J. R. LEIGHTY, recently corporate chief engineer, Missouri Pacific R.R., has been appointed assistant to the vice-president, with headquarters at St. Louis.

C. W. CHEATHAM, of the Missoula office, U. S. Bureau of Public Roads, has been appointed senior highway engineer of the bureau in Alaska.

A. S. BALDWIN, recently corporate vice-president, Illinois Central R.R., has been elected vice-president in charge of Chicago terminal improvements.

OBITUARY

MELVIN B. NEWCOMB, chief engineer, rubber machinery department, Wellman-Seaver-Morgan Co., died March 13, after a short illness, at his home in Akron, Ohio. Mr. Newcomb was born in Bridgeton, N. J., in 1889. He received his mechanical engineering education at the University of Wisconsin. At various times he was connected with the I. P. Morris Co., Philadelphia, Allis-Chalmers Mfg. Co., Milwaukee, Wisconsin Engine Co., Corlis, Wis., and the Firestone Tire & Rubber Co., Akron. In 1918 he joined the hydraulic turbine department of the Wellman-Seaver-Morgan Co., and a few months later was appointed chief engineer of the rubber machinery department.

CHARLES H. MCCULLOUGH, JR., president of the Lackawanna Steel Co., died at Baltimore, April 3, aged 51 years. He was born in Philadelphia, and was a graduate in mechanical engineering of Stevens Institute of Technology. In 1891, he became associated with the Illinois Steel Co. at its South Works plant, Chicago, and served in various capacity in that company, finally becoming vice-president. He resigned, in 1905, to become vice-president and general manager of the Lackawanna Steel Co., and was elected president, Jan. 1, 1919.

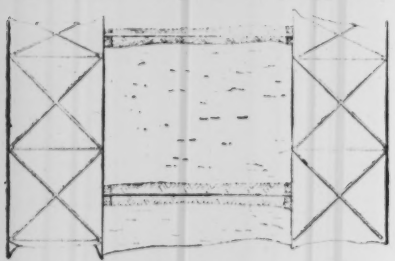
HENRY FOSTER NEWELL, for eight years a member of the engineering staff of the Panama Canal Commission, died at Ancon, April 5. He was born at Bradford, Pa., in 1882. Previous to his work in the canal zone, he was engaged in surveying and general engineering work in the Southwest, serving at one time in a machine-gun company on the Mexican border. His principal work was in connection with exploration and detailed mapping of the tributaries of the Chagres River, and the location of works for the defense of the Panama Canal. He was a brother of F. H. Newell, former chief engineer and director of the U. S. Reclamation Service, now professor of civil engineering at the University of Illinois.

Patent Sought on New Floor Block

B. S. McConnell, one of the department managers of the Republic Creosoting Co., Indianapolis, Ind., has applied for patent on a new floor block used in the construction of factory floors. Mr. McConnell s invention consists in cutting off each of the four corners of each block, to provide space for the penetration of whatever binder is used.

Patent Issued on Automobile Railway Track

A patent has recently been issued to John J. Ahearn, Palmer, New York, upon what the patentee calls an "automobile railway-track." The track consists of T-rails formed upon supporting plates and tied at intervals with tie-rods. The tread face of the T-rail is provided with various designs for preventing automobiles or other vehicles from skidding or slipping. Short ties are secured to the supporting plates of the rails by spikes and the ties and rails are then embedded within cement so that the tread plates are disposed in a plane with the surface of the roadbed. The invention is presumably applicable



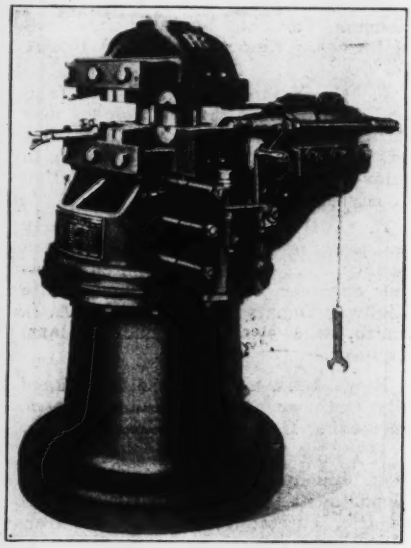
T-RAILS WITH SPECIAL TREAD SURFACE FORM HEAVY TRAFFIC ROADWAY

to any type of road surface. The accompanying drawing shows the type of construction and the tread face preferred by the inventor.

Improved Drill Steel Sharpener

A new compressed air, drill steel sharpening machine—the I-R No. 50 Sharpener—has been developed by the Ingersoll-Rand Co., New York City. It was designed primarily to sharpen and shank cruciform steel up to 2 in. in diameter, or round, hexagonal, octagonal, quarter-octagonal, auger or spiral steel up to 1¼ in. However, it has performed other tasks and, when fitted with special devices, will forge boltheads, pins, stanchions, etc. In fact, nearly 200 different products have been made by it.

The single lever, which controls all of the machine's operations, is fitted with a safety locking device. The



NEW COMPRESSED AIR MACHINE MAKES 200 PRODUCTS

throttle valve is of the balanced spool type and operates easily and quickly. The hammer cylinder is an improved valveless type. A substantial base and the Ingersoll-Rand "heartbeat" system of lubrication are other features.

BUSINESS NOTES

HAROLD E. KETCHUM, vice-president, Graff Construction Co., Seattle, Wash., has been made general manager, Francis A. Vaughn Mfg. Co., Milwaukee, Wis., manufacturers of column clamps, tools and contractors' equipment. Mr. Ketchum has been in charge of construction work for the past twelve years on engineering structures, notable among which are the Detroit-Superior high level bridge, Cleveland, the Twelfth St. Trafficway, Kansas City; bridges eight and nine, Canadian Northern Ry., B. C., and the general storehouse at Bremerton Navy Yard. During the past three years he has constructed and equipped the factories of the American Nitrogen Products Co., at LaGrande, Wash., and Vancouver.

THE AMERICAN CONCRETE PIPE ASSOCIATION elected the following officers at its annual convention held in Chicago, Feb. 20 and 21: President, A. N. Shearman, Knoxville, Tenn.; vice-presidents, Ernest Bent, Los Angeles; Harry K. Cain, Mankato, Minn.; A. M. Hirsh, New York. Manager, G. E. Warren, 210 South LaSalle St., Chicago.

THE PORTLAND CEMENT ASSOCIATION announces the opening of a new office at 146 Fifth St., Portland, Ore., with Hans Mumm, Jr., as district engineer in charge.

THE SHOCKLEY ENGINEERING CO., Kansas City, Mo., announces its removal to larger quarters in the Graphic Arts Bldg., that city.

DAYTON-DOWD CO., Quincy, Ill., announces the opening of a branch office in Cleveland, under the management of L. E. Maher, Maher Engineering Co., Chicago. This office will handle the line of Dayton-Dowd centrifugal pumps in addition to other mechanical equipment, and is prepared to give prospective pump users complete information covering their problems.

THE JAMES LEFFEL & CO., Springfield, Ohio, manufacturers of turbine water wheels, has moved its Boston offices from 79 Milk St. to 161 Devonshire St. This office will be in charge of A. S. Addison, who will be transferred from the main office and factories in Springfield.

W. D. WARD, for the past twenty-five years sales engineer in the home office of the Pelton Water Wheel Co., San Francisco, has been appointed manager of the company's Atlantic department, 90 West St., New York.

THE CHICAGO PNEUMATIC TOOL CO., has transferred its general offices to the Chicago Pneumatic Building, erected for the company at 6 East 44th St., New York City. The Chicago district sales branch, previously in the Fisher building, has moved to 300 North Michigan Boulevard, and the service branch has been consolidated with the sales branch, both departments to be under the direction of J. L. Canby.

THE F. C. AUSTIN MACHINERY CO., Chicago, has been incorporated to take over the business of the F. C. Austin Co., Inc., the Municipal Engineering & Contracting Co. and the Muskegon plants of the Linderman Steel & Machine Co., retaining the personnel of those companies. F. C. Austin, however, retires from active management, and B. A. Linderman assumes control. The offices of the combination will be in the Railway Exchange Building, Chicago.

THE JEFFREY MANUFACTURING CO., Columbus, Ohio, has opened a new branch office in Los Angeles, to take care of its business in California, Arizona, Nevada and the State of Sonora, Mex. The office will be in charge of F. R. Field, recently manager of the Denver office of the company.

R. E. S. GEARE, of Geare and Co., engineers, specializing in sales engineering in the construction and power plant field, which concern has for the past four years handled the business of the T. L. Smith Co., of Milwaukee, has been appointed general sales manager of the Smith Co., in charge of its general sales offices in the Old Colony Bldg., Chicago, where the advertising and sales departments are now located.

RALPH G. MACY has resigned as chief engineer of the Walter Kidde Co., to join the engineering staff of the Engineering & Appraisal Co., New York City.